LASAIR® Particle Counter

Operations Manual

Without measurement, there is no control.

PARTICLE MEASURING SYSTEMS
www.pmeasuring.com

P/N M10138

LASAIR® Particle Counter

Operator's Manual

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LASAIR Particle Counter Operator's Manual
P/N M10138 Rev F
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Quality Statement

The Quality Policy of Particle Measuring Systems is to strive to meet or exceed the needs and expectations of our customers, and to align the activities of all employees with the common focus of customer satisfaction through continuous improvement in the quality of our products and services.

Environmental Information

This equipment must be properly disposed of at end-of-life by means of an authorized waste management system. Information regarding dismantling of the equipment and location of any hazardous materials can be located on our web site at: http://www.pmeasuring.com/support/papers/disassemblyinstructions.

Manual Conventions

WARNING

A warning in the text is used to notify the user of the potential for bodily injury or death.

CAUTION

A caution in the text is used to highlight an item that if not done, or incorrectly done, could damage the instrument and/or any materials or devices affected by the instrument.

– — NOTICE — –

A notice in the text is an instructional communication regarding requirements or policies issued by Particle Measuring Systems.

NOTE: A note in the text is used to highlight an item that is of operational importance to the user.

It is important that you observe cautions and warnings while performing the procedures described in this manual. Caution and warning labels are located on and inside the instrument to alert you to potentially hazardous conditions. Please familiarize yourself with this information.

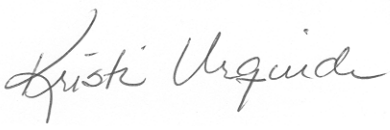
CE – Declaration of Conformity

CE - Declaration of Conformity

Application of Council Directive(s):	89 / 336 /EEC, 73 / 23 /EEC	
Standard(s) to which Conformity is Declared:	EMC	EN 61326: 1997/A1: 1998/A2: 2001
	Safety	EN 61010-1: 2001
Manufacturer's Name:	Particle Measuring Systems, Inc.	
Manufacturer's Address:	5475 Airport Boulevard, Boulder, CO 80301 USA	
Manufacturer's Telephone/FAX:	(303) 443-7100 / (303) 449-6870	
Distributor's Name:	Particle Measuring Technique, Great Britain	
Distributor's Address	Unit B1 South, Willow End Park	
	Danemoor, Malvern WR14 1XZ	
	Worchestershire, WR13 6NN United Kingdom	
Distributor's Telephone/FAX:	011-44-1684-312950 / 011-44-1684-312969	
Type of Equipment:	Particle Monitoring	
Model No:	LASAIR	

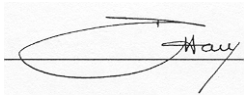
I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s).

Signature:



Full Name:	Kristi Urquidi
Position:	Vice President Operations
Place: Boulder	Date: January 6, 2002

Signature:



Full Name:	David Hall
Position:	Managing Director
Place: Malvern	Date: January 9, 2002

WARNING

All I/O cables and accessories must meet current factory specifications in order for this unit to remain in compliance with CE marking requirements. Consult the factory for details.

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Chapter 1
Unpacking, Installation, and Cabling

Unpacking the LASAIR

To unpack your LASAIR:

1. Carefully remove the LASAIR from its shipping container.
2. If the instrument has been damaged in shipment, notify the shipper immediately.
3. Ensure that a power cord is included with the instrument.
4. If the power cord is missing, contact Particle Measuring Systems immediately for replacement.

   Probes, sensors, and aerosol manifolds are shipped separately with their own connectors, cabling, and setup and operating instructions. Please study the respective documents before using these instruments with the LASAIR.

Preparing the Sample Inlet

Sampled air enters the LASAIR through the sample inlet located on the top of the instrument (refer to Figure 1-1). The LASAIR is shipped with a short length of tubing installed on the sample inlet fitting. A tie wrap has been placed on the tubing to prevent contamination. Ambient air can be sampled through this piece of tubing or through an isokinetic sampling probe. Remote samples can be collected using an isokinetic sampling probe or an aerosol manifold, or by attaching the required length of sample tubing.

CAUTION:
Do not run the LASAIR without an inlet filter where the particle concentration is greater than 10 times the concentration of intended use; otherwise, the inlet tubing and inlet jet may require cleaning before zero counts or valid data can be obtained.

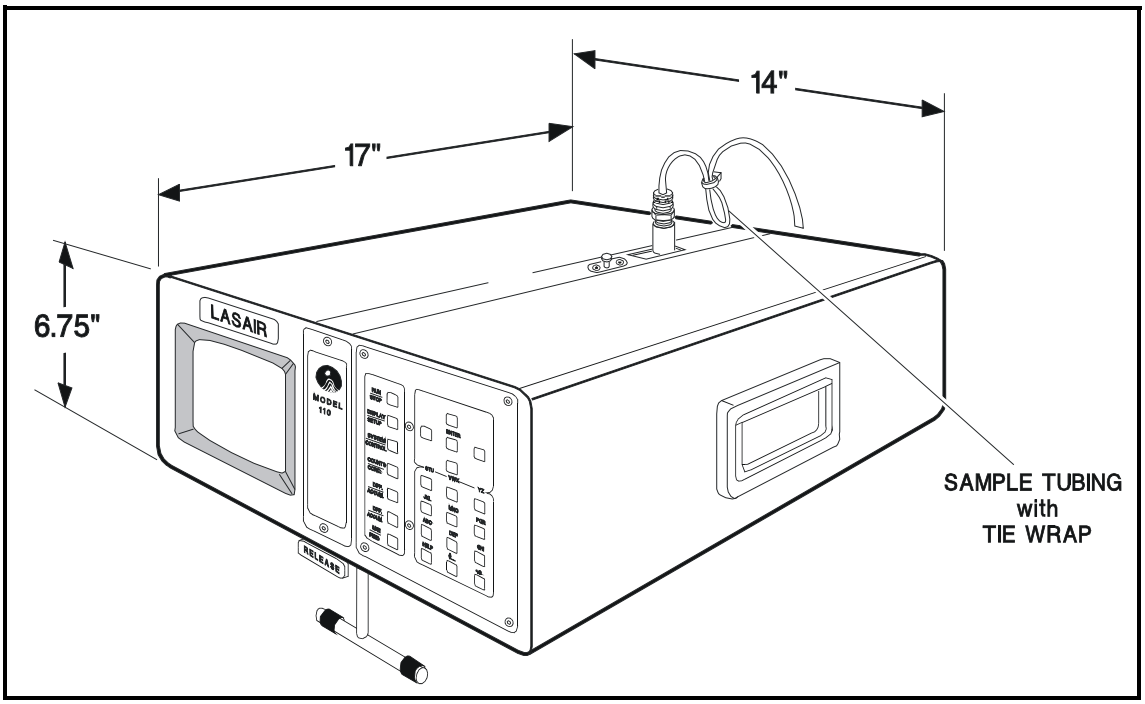


Figure 1-1: LASAIR Dimensions and Sample Tubing Tie Wrap

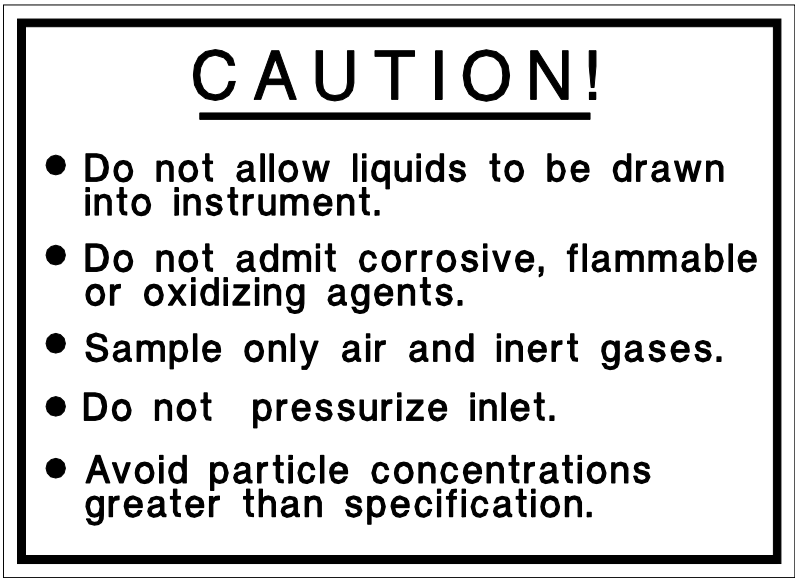
NOTE: Although ambient air or air from remote locations can be sampled using just a sample tube, it is preferable to use an isokinetic sampling probe.

To prepare the sample inlet:

1 Remove the tie wrap from the sample tubing.

CAUTION:
Failure to remove the tie wrap from the sample inlet before running the LASAIR may damage the pump.

CAUTION:
On LASAIR units incorporating a sample return, remove the cap from the Sample Return fitting on the rear panel before the power is turned on.


CAUTION!
• Do not allow liquids to be drawn into instrument.
• Do not admit corrosive, flammable or oxidizing agents.
• Sample only air and inert gases.
• Do not pressurize inlet.
• Avoid particle concentrations greater than specification.

2 If ambient air is to be sampled, either leave the factory-installed tubing on the sample inlet, or attach a length of sample tubing and the isokinetic sampling probe to the sample inlet. Fittings must be finger-tightened only!

3 If air from another location is to be sampled, remove the factory-installed tubing from the sample inlet, install the required length of sample tubing on the sample port, and finger-tighten the fitting on the port. If an isokinetic probe is to be installed, connect the probe to the sample tubing.

4 If air is to be sampled through an aerosol manifold, refer to the aerosol manifold manual for installation instructions.

NOTE: If you must use long sections of tubing to sample from remote locations, check the airflow rate at the instrument to make sure the flow rate has not degraded. If the flow is degraded please see "Airflow Rate Adjustment (All LASAIR models except for LASAIR-1004)" on page 11-15.

It is recommended that tubing connected at the inlet be no more than 10 feet in length. Use metal tubing for long lengths and do not use tubing that has many turns or kinks. With longer lengths of tubing a loss of sensitivity to larger particles is possible due to settling in the line.

Sample tubing for 1 CFM counters is 3/8-inch OD. Sample tubing for 0.01 CFM counters and below 0.01 CFM counters is 1/8 inch OD.

Rear Panel Connections

Refer to Figure 1-2 to complete the connections to the rear panel. (A LASAIR-110 unit is shown in the Figure below.

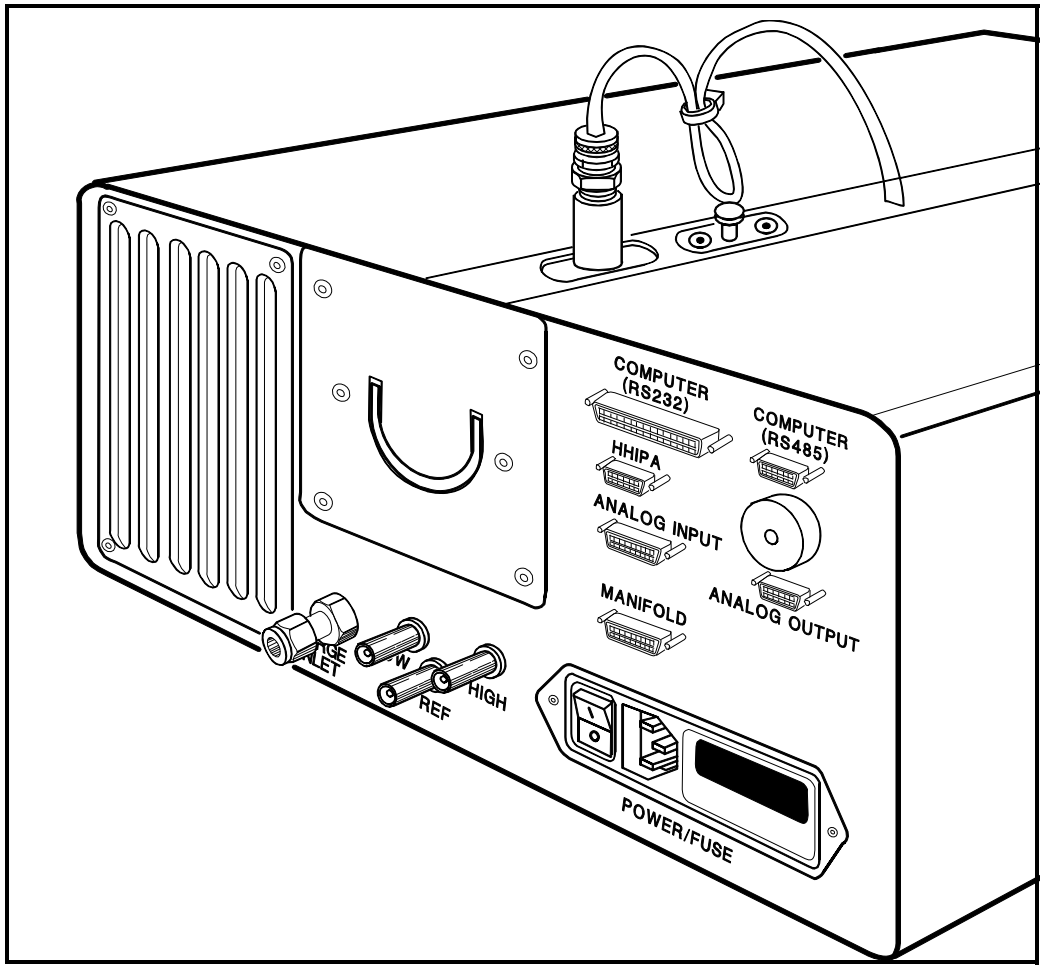


Figure 1-2: LASAIR 110 Rear Panel

To complete the rear panel connections:

1. If you are using an aerosol manifold, plug the signal cable from the AMI (Aerosol Manifold Interface) into the 15-pin connector labeled MANIFOLD.
2. If you are using an analog sensor (for example, a temperature or humidity probe), connect it to the 15-pin connector labeled ANALOG INPUT.
3. If you are using a PMS Hand Held Isokinetic Probe - Audible (HHIPA), connect it to the 9-pin connector labeled HHIPA.
4. If the LASAIR is to communicate with a computer, use the RS-232C or RS-485 serial communications port labeled COMPUTER.

   Table 1-1 lists the connectors and outlets located on the rear panel and their functions.

Table 1-1: Rear Panel Connectors and Outlets

Label	Specification	Purpose
POWER		Main power source
COMPUTER (RS-232)	RS-232, DB25S	Communication link to computer (less than 50 feet)
COMPUTER (RS-486)	RS-485, DB9P	Communication link to computer (greater than 50 feet)
ANALOG INPUT	4-20 mA, DB15S	Analog sensor
ANALOG OUTPUT	0-5V 4-20 mA, DB9S	Particle concentration
HHIPA	Pulsed, DB9S	HHIPA connector
MANIFOLD	SB15P	Aerosol manifold signal interface
LOW/HIGH/REF	BNC (male)	Monitor low and high gain signals and the laser reference voltage

Connection to Power

CAUTION:

Do not connect the instrument to a supply when damage is present. Internal electrical damage could result in shock if the instrument is turned on.

After all other connections are made, connect the LASAIR to a power source:

1. Plug the female end of the power cord into the power connector located on the lower right of the rear panel.
2. Plug the other end into a grounded wall outlet.
3. Turn the LASAIR on by pressing the power switch located next to the power connector on the back panel.

WARNING:

AC Operation

NOTE: AC voltage values are ranges only. The instrument voltage setting is preset at the factory and is indicated on the instrument rear panel power label.

Table 1-2: Power Requirements

LASAIR Models	AC Voltage	AC Current
110, 1510, 210, 310	47 to 63 Hz at 90-132 V	5.0 A
	47 to 63 Hz at 188-264 V	2.5 A
101	47 to 63 Hz at 90-132 V	2.5 A
	47 to 63 Hz at 188-264 V	1.6 A
1001, 1002, 1003, 1004	47 to 63 Hz at 90-132 V	2.5 A
	47 to 63 Hz at 188-264 V	1.6 A

AC Fusing

The fuse drawer in the power entry module on the instrument permits the use of either a North American (3 AG, UL/CSA) or European (5 x 20 mm IEC) style fuse.

To replace a fuse:

1. Use a small blade screwdriver or similar tool, remove the Cover/Fuse draw from the Power Entry Module located on the instrument rear panel.
2. Refer to instrument rear panel power label to determine if North American or European fusing is being used.
3. Reinstall the Cover/Fuse drawer assembly.

Table 1-3: Fuses

LASAIR Models	North American	European
110, 1510, 210	5.0 Amp 3 AG SB/250 V	2.5 A T 5x20 mm 250 V
101	2.5 Amp 3 AG SB/250 V	1.6 A T 5x20 mm 250 V
1001, 1002, 1003, 1004	2.5 Amp 3 AG SB/250 V	1.6 A T 5x20 mm 250 V

Cooling Air Exhaust Filter

To help reduce cleanroom contamination, the LASAIR filters its exhausted cooling air. If the LASAIR is used in a dirty environment (outside a cleanroom) the cooling air exhaust filter will also have to absorb additional particles carried into the LASAIR by the cooling air. These additional particles will shorten the life of the filter element, reduce cooling airflow and increase the internal temperature of the LASAIR.

NOTE: When operating a LASAIR outside of a cleanroom, removal of the cooling air filter element is recommended.

Removing the Filter Element

To remove the filter element:

1. Turn off the LASAIR power switch and unplug the power cord.
2. Remove the four screws from the filter grill (refer to Figure 1-3) using a 1/16 in. hex head screwdriver.
3. Carefully remove the filter element from the rear of the LASAIR. Do not touch the filter material pleats. Touch only the plastic shell. It may help to push the filter element shell from inside the LASAIR. Remove the right-side cover by following the procedures listed under “Airflow Rate Adjustment (All LASAIR models except for LASAIR-1004)” on page 11-15.

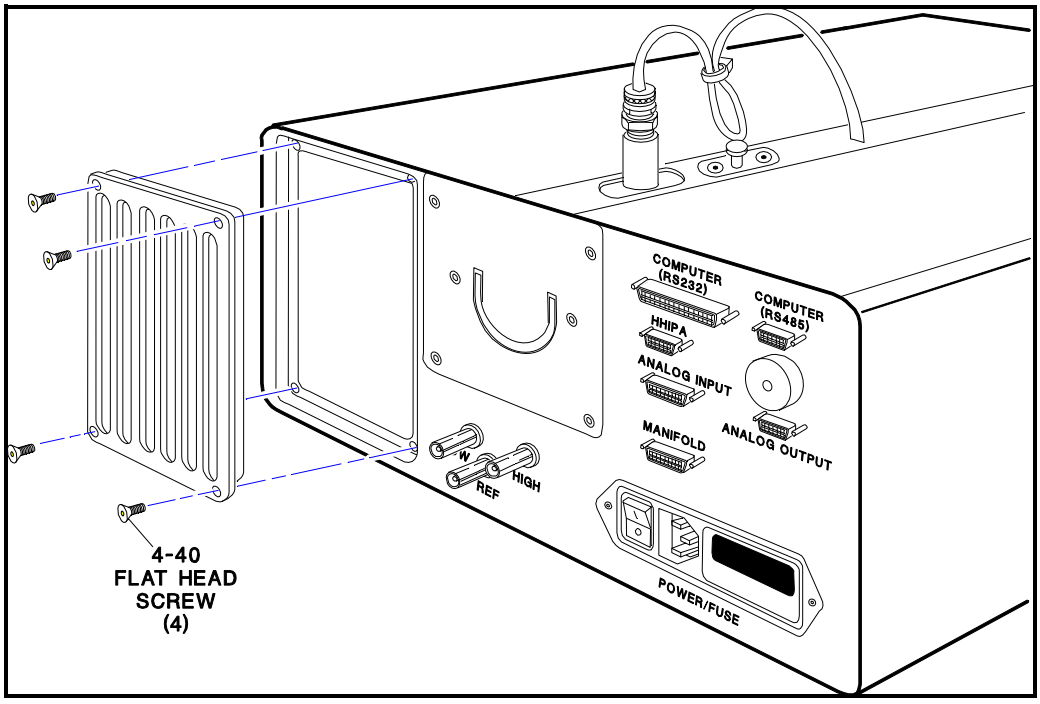


Figure 1-3: Removing the Filter Element

4 Store the filter element in a clean self-sealing plastic bag for future use.

5 Replace the filter grill and four screws.

Chapter 2
Specifications

Table 2-1: Particle Sizing Channel Thresholds
Particle Size Class (diameter in microns)

LASAIR	1	2	3	4	5	6	7	8
110	0.1 - 0.15	0.15 - 0.2	0.2 - 0.25	0.25 - 0.3	0.3 - 0.5	0.5 - 0.7	0.7 - 1.0	>1.0
1510	0.15 - 0.2	0.2 - 0.3	0.3 - 0.5	0.5 - 0.7	0.7 - 1.0	1.0 - 2.0	2.0 - 5.0	>5.0
210	0.2 - 0.3	0.3 - 0.5	0.5 - 0.7	0.7 - 1.0	1.0 - 2.0	2.0 - 3.0	3.0 - 5.0	>5.0
101	0.1 - 0.2	0.2 - 0.3	0.3 - 0.4	0.4 - 0.5	0.5 - 0.7	0.7 - 1.0	1.0 - 2.0	>2.0
1001	0.1 - 0.2	0.2 - 0.3	0.3 - 0.4	0.4 - 0.5	0.5 - 0.7	0.7 - 1.0	1.0 - 2.0	>2.0
1002	0.1 - 0.2	0.2 - 0.3	0.3 - 0.4	0.4 - 0.5	0.5 - 0.7	0.7 - 1.0	1.0 - 2.0	>2.0
1003	0.1 - 0.2	0.2 - 0.3	0.3 - 0.4	0.4 - 0.5	0.5 - 0.7	0.7 - 1.0	1.0 - 2.0	>2.0
1004	0.1 - 0.2	0.2 - 0.3	0.3 - 0.4	0.4 - 0.5	0.5 - 0.7	0.7 - 1.0	1.0 - 2.0	>2.0

Table 2-2: Functional Specifications

LASAIR Model #	110	1510	210	101	1001	1002	1003	1004
Size Range	0.1-1.0µm	0.15-5.0µm	0.2-5.0µm	0.1-2.0µm	0.1-2.0µm	0.1-2.0µm	0.1-2.0µm	0.1-2.0µm
Flow rate	≥ 50% at 0.10 µm	≥ 50% at 0.15 µm	≥ 50% at 0.20 µm	≥ 50% at 0.10 µm	≥ 50% at 0.10 µm	≥ 50% at 0.10 µm	≥ 50% at 0.10 µm	≥ 50% at 0.10 µm
Counting efficiency	≥ 50% at 0.10 µm	≥ 50% at 0.15 µm	≥ 50% at 0.20 µm	≥ 50% at 0.10 µm	≥ 50% at 0.10 µm	≥ 50% at 0.10 µm	≥ 50% at 0.10 µm	≥ 50% at 0.10 µm
Zero Count Level	<1.0 ft.^{3} or <1.0/min.	<1.0 ft.^{3} or <1.0/min.	<2.0 ft.^{3} or <1.0/min.	<2.0 ft.^{3} or <0.2/min.	<2.0 ft.^{3} or <0.2/min.	<100.0 ft.^{3} or <0.2/min.	<100.0 ft.^{3} or <0.2/min.	<100.0 ft.^{3} or <0.2/min.
Size channel thresholds	8 channels with thresholds at:							
	0.15, 0.2, 0.3, 0.5, 0.7, & 1.0, 2.0, & 5.0 µm	0.1, 0.15, 0.2, 0.25, 0.3, 0.5, 0.7, & 1.0 µm	0.1, 0.2,0.3, 0.5,0.7, 1.0, 2.0, 3.0, & 5.0 µm	0.1, 0.2,0. 3,0.4, 0.5, 0.7, 1.0, & 2.0 µm	0.1, 0.15, 0.2, 0.25, 0.3, 0.5, 0.7, & 1.0 µm	0.1, 0.2, 0.3, 0.4 0.5, 0.7, & 1.,0 & 2.0 µm	0.1, 0.2, 0.3, 0.4, 0.5, 0.7, 1.0, & 2.0 µm	0.1, 0.2, 0.3, 0.4, 0.5, 0.7, 1.0, & 2.0µm
Max. concentration	70,000 ft.^{3}	100,000 ft.^{3}	750,000 ft.^{3}	500,000 ft.^{3}	10,000,000 ft.^{3}	50,000 ft.^{3}	384,000 ft.^{3}	640,000 ft.^{3}

Functional Specifications Continued

Cavity Design	Passive
Optical Design	Wide angle 90° scattering collecting optics with greater than 2π steradians solid angle
Laser Source	HeNe
Cooling air	Filtered cooling air
Purge/Sheath air	Filtered air purge of optical system
Display and control	5” CRT and 24-key alphanumeric keyboard with hard function controls
Sampling length	6 seconds to 99:59:59 (hh:mm:ss) programmable, or manual
Sampling mode	single or continuous
Delay time	0 seconds to 99:59:59 (hh:mm:ss) programmable
Data analysis	Automatic processing of up to 99 samples, stores up to 1470 samples in a time series plot
Screen output	Date of sample, instrument identification, sample interval, sample volume, software version, manifold activity, Manifold position, sample number, 8 size channels, laser reference voltage, airflow rate in CFM, and analog input values
Analog inputs	Four 4-20 mA or 0-10 volts
Computer interface:	RS-232 and RS-485 bi-directional
Data output	Date, time, instrument identification, sample number, sample interval, sample time remaining, 8 size channels, alarms, laser reference, flow rate, cumulative & differential counts, concentration or actual counts, manifold position, environmental sensor data, and analog output settings.
Calibration	Calibration materials are used are traceable to the USA National Institute for Standards and Technology and to one or more of the following procedures: ASTM F-328 ASTM f-649
Power	100, 115, 220 or 240 volts, 50-60 Hz, 5 amps maximum
Dimensions (l,w,h,)	17 x 14 x 6 inches (43.2 X 35.6 x 15.2 cm)
Weight	42 lbs. (19.0 kg)
Environment	Temperature: 10-25°C Humidity: 0-95% noncondensing Altitude: 0-5500 ft. (1676 meters)

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Chapter 3
Measurement Technique

This chapter briefly describes the operation of the LASAIR, including the following items:

- optics
- particle imaging
- flow system
- data system

The LASAIR sizes and counts particles by measuring the amount of light scattered from each particle. The source of illumination is a 10-milliwatt HeNe laser. The patented passive optical cavity is defined by the laser output coupler mirror and a mirror-coated quartz crystal which is part of an oscillator circuit (Figure 3-1). The vibration of the crystal shifts the wavelength of the reflected light to maximize the transfer of power into the external passive cavity while minimizing reflection of coherent light back into the laser. The cavity has a resonant Q of approximately 100. When it is driven with the 10-milliwatt HeNe laser, a one-watt beam is available to illuminate particles.

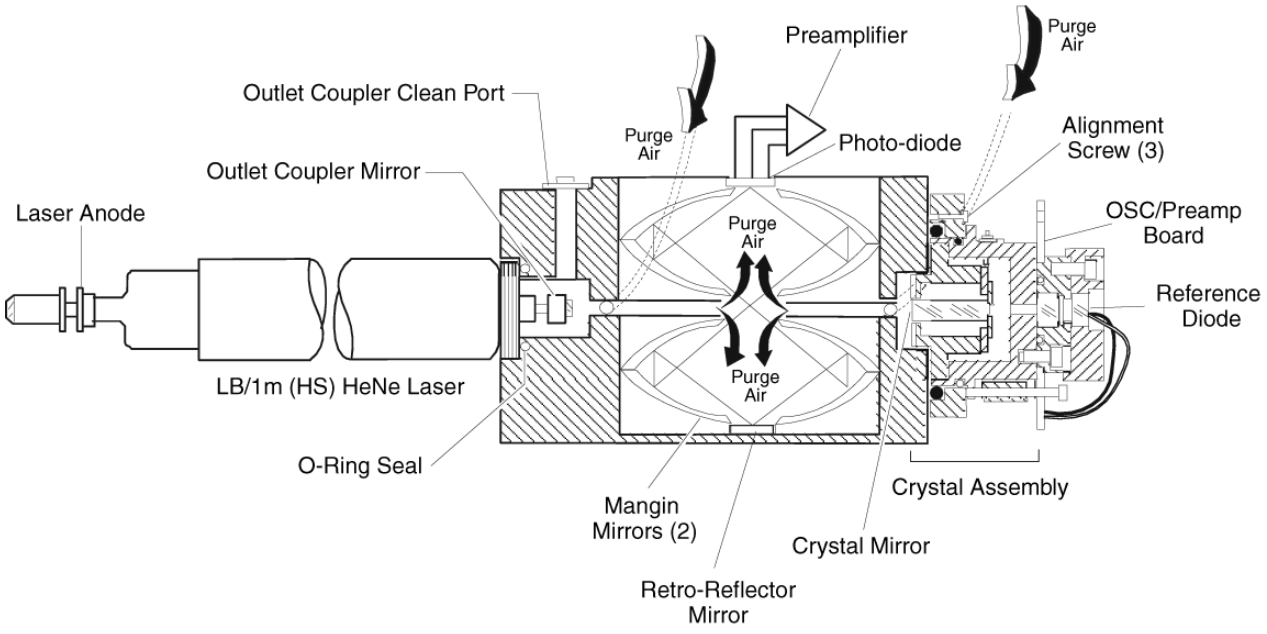

Figure 3-1: Passive Optical Cavity

The LASAIR flow system provides a sample flow. The system includes a pump, filters, flow meter, inlet jet and outlet jet. The LASAIR-1004 also incorporates a Mass Flow controller. The jet tip defines the size, shape, and position of the sample stream in relation to the laser beam. A purge flow is drawn across the sample cavity mirrors to keep the laser optics clean while sampling.

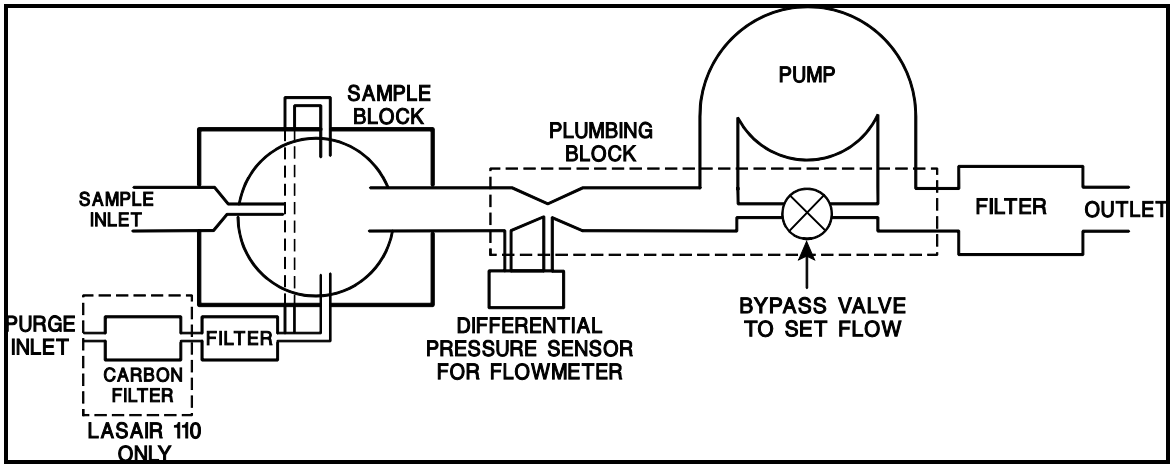

Figure 3-2: Flow System for the 1.0 CFM Model

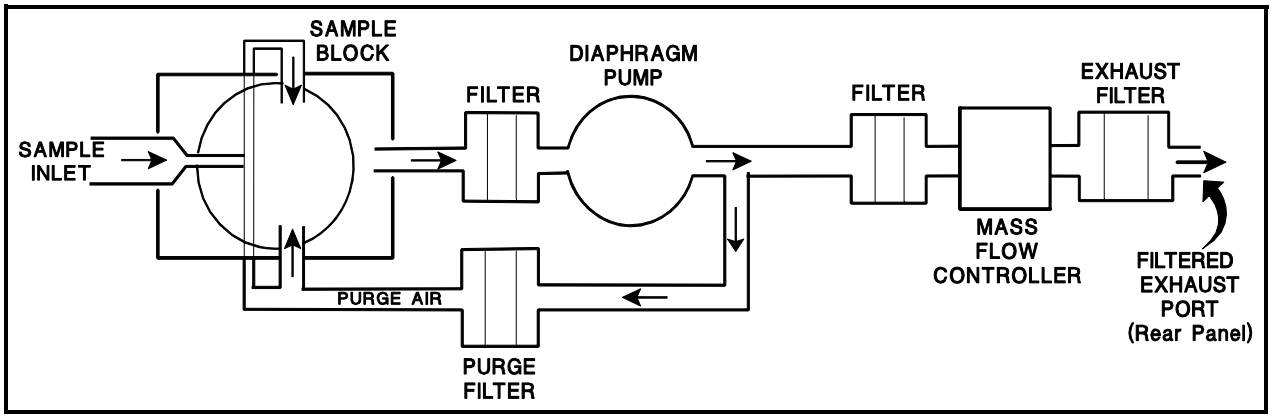

Figure 3-3: LASAIR 101 Flow System

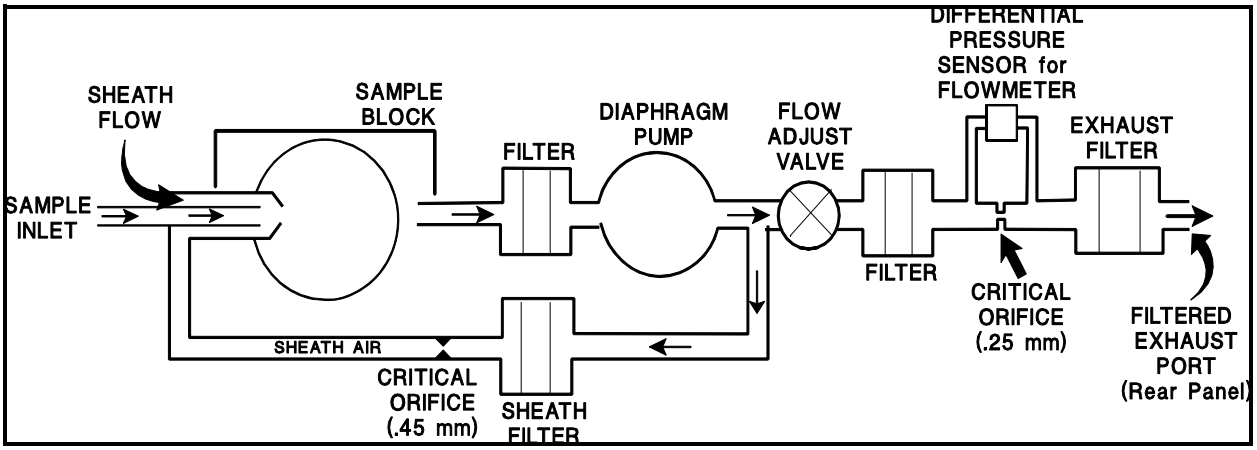

Figure 3-4: LASAIR 1001, 1002, and 1003 Flow System

The collecting optics include four Mangin mirrors and a solid-state photodetector. The mirrors are anti-reflective A-R coated for minimal light loss. One set of mirrors is located on each side of the laser optical bench. The collecting optics provide one-to-one magnification of scattered light to the detector. The amplified signal from the photodiode is proportional to the size of the particle and the brightness of the illumination. This signal is compared to the reference voltage derived from laser light leaked through the crystal mirror to provide automatic gain control.

The data system tallies the particles in each size bin, processes and displays the data.

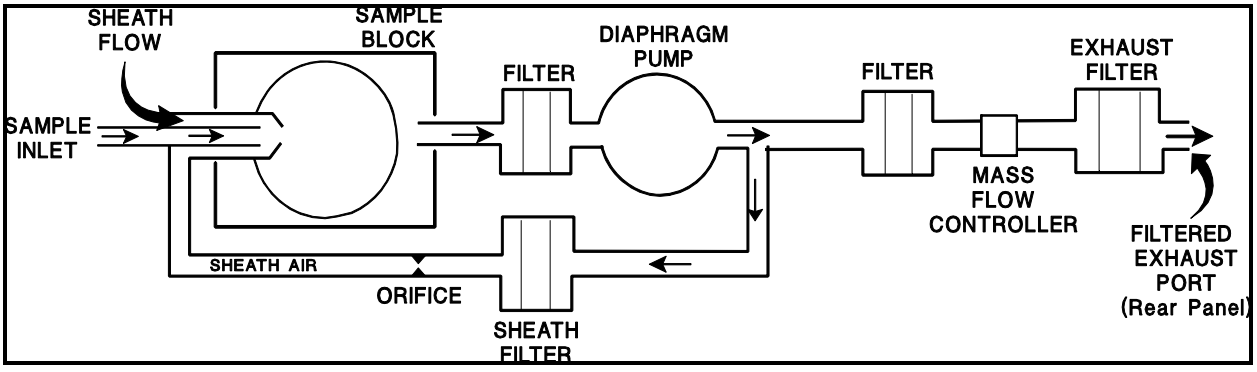

Figure 3-5: LASAIR 1004 Flow System

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Chapter 4
Getting Started

When you receive the LASAIR it is important to run a short check to ensure that the instrument has not been damaged in shipment. The performance procedures in this chapter are designed to determine whether your instrument is operating properly. Perform these procedures upon initial power-up and when you question the accuracy of reported data.

One of the performance procedures, Background Count Check, will enable you to sample and produce a printed report. This sampling and reporting procedure is cursory, but it allows you to see how the data appears and how printouts can be obtained. More complete information on configuration of the LASAIR for sampling is contained in Chapters 5, 7, 8 and 9.

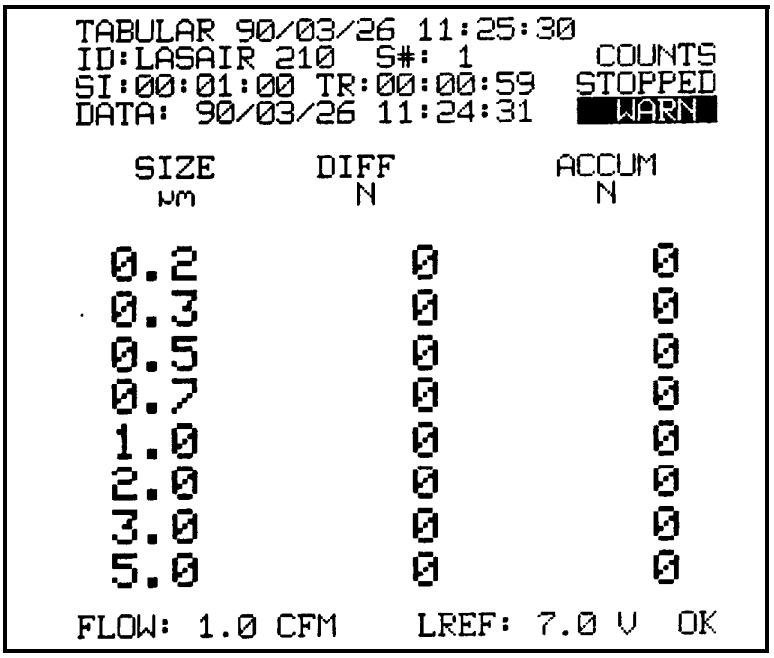
This chapter tells you how to:

- turn the LASAIR on
- run through the initial acceptance and performance checks that ensure operability
- run a sample

To turn the LASAIR On:

1 After reading Chapter 1, turn the LASAIR on by pressing the power switch located next to the power connector on the back panel.

The LASAIR displays a screen similar to the following:



The LASAIR always displays a “Power Interruption” warning on power-up.

2 To remove the warning message from the data screen, press the Enter key (marked with an E) twice.

Performance Checks

Complete the following procedures to verify that your instrument is operating properly.

Reference Voltage Check

The reference voltage is a measurement of inner cavity laser power. A certain voltage level must be present to maintain an adequate signal-to-noise ratio and, therefore, ensure receipt of accurate data. While a minimum reference voltage of 4.5 volts is considered adequate for operation, the optimal level is between 7.0 and 9.5 volts.

No special equipment is needed to perform this procedure.

To check the laser reference voltage:

1 To check the reference voltage, look at the bottom right corner of the display. The reference voltage (LREF:) is updated each second.

2 Allow the instrument to run for an hour.

3 If the laser voltage is over 7.0 volts after one hour the unit is operating properly. If after one hour the reference is not over 7.0 volts refer to Chapter 10 “Troubleshooting.”

Airflow Rate Check

The LASAIR sets the airflow rate according to the site elevation. The current flow rate is reported in the lower left corner of the display. The reported flow rate should be:

Unit Type	Flow Rate	Tolerance
All 1 CFM units	1.0 CFM	± 5%
LASAIR 101	0.10 CFM	± 5%
LASAIR 1001	0.010 CFM	± 5%
LASAIR 1002	0.0020 CFM	± 5%
LASAIR 1003	0.0010 CFM	± 10%
LASAIR 1004	0.280 cc/sec.	± 10%

No special equipment is needed to perform this procedure.

To check the airflow rate for your site elevation:

1 If you are currently viewing a data display (shows either TABULAR, PERCENT, LINEAR, LOG, SERIES, or ANALOGS in the upper left corner), press the DISPLAY/SETUP key once to go to the Setup Menu.

2 From the Setup Menu (shows SETUP in the upper left corner), make sure the cursor (flashing light) is on option 1. If it is not, move it there using the up- and down-arrow keys. Then press the Enter key to select Instrument Configuration.

3 Press the Enter key (eight times) until the monitor displays:

Site Elevation (ft.).

4 Enter your site elevation in feet using the alphanumeric keypad and right- and left-arrow keys to position the cursor.

NOTE: For more information about using the alphanumeric keypad, see “Using the Alphanumeric Keypad” on page 5-14, or press the Help key.

Unit Type	Flow Rate	Tolerance
All 1 CFM units	1.0 CFM	± 5%
LASAIR 101	0.10 CFM	± 5%
LASAIR 1001	0.010 CFM	± 5%
LASAIR 1002	0.0020 CFM	± 5%
LASAIR 1003	0.0010 CFM	± 10%
LASAIR 1004	0.280 cc/sec.	± 10%

5 When your site elevation is correctly shown, press Enter to confirm your entry; press Enter again to return to the Setup Menu.

6 Monitor the flow rate in the lower left corner of the display. It should be correct for your elevation.

7 Press Display/Setup key again to return to the tabular screen.

Background Count Check

Perform this check upon installation or when you suspect contamination may be causing false data. If noise-induced counts are suspected contact the Particle Measuring Systems Service Department.

A PMS-FL03 filter T (PMS-FL01 zero count filter for the LASAIR-1001 or PMS-FL02 for the LASAIR-101) assembly or equivalent source of air known to be cleaner than the specification of no more than 0.2 particles per cubic foot greater than 0.1 microns is needed for this procedure.

To check for background counts:

1 Locate the LASAIR where it will normally be used.

2 Place the filter assembly in series with the sample inlet tube, or connect a source of known clean air to the sample inlet (Figure 4-1).

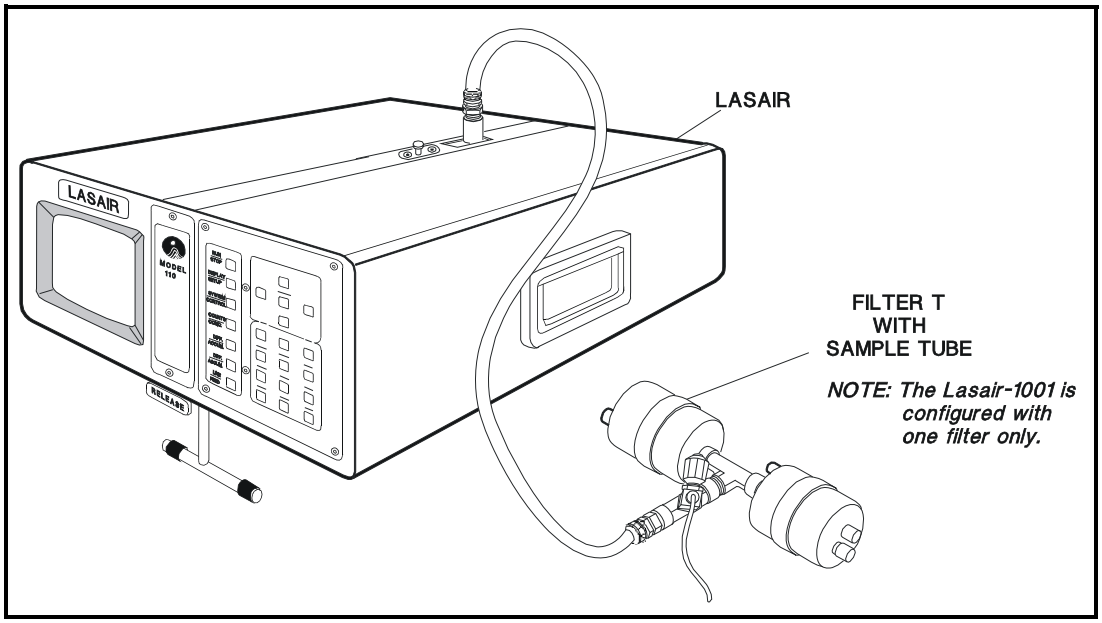


Figure 4-1: Sample Inlet Setup

3 To configure the LASAIR to take six 10-minute samples, select option 2, Sampling Control (move the cursor to option 2 and press Enter), from the Setup Menu and make the following entries:

Sample Length: 00:10:00

# of Samples in Group: 06

Sample Delay Length: 00:00:00

Continuously Repeat Group: NO

Use the alphanumeric keypad and right- and left-arrow keys to enter the numbers; use the right-and left-arrow keys to toggle to the appropriate YES/NO selections. Press Enter at the end of each line.

NOTE: For more information about using the alphanumeric keypad, see "Using the Alphanumeric Keypad" on page 5-14, or press the Help key.

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4 When the entries are displayed correctly, press Enter to return to the Setup Menu.

5 Press the DISPLAY/SETUP key to return to the data display. If you are not at the TABULAR data display, use the right- or left-arrow key to locate it.

6 To begin sampling, press the RUN/STOP key from the TABULAR data display.

The LASAIR begins the series of six 10-minute samples and the data are reported in real-time on the display as both differential and accumulative counts. The results should be less than 2 accumulative (ACCUM) counts per 10 minutes.

7. If more than 2 counts per 10 minutes are reported, see “Background Counts” on page 10-2.
8. Return the instrument to normal operation by removing the filter from the sample line.

Sampling Reports

Sampling is started and stopped by pressing the RUN/STOP key from either the setup screen or any of the data screens. Sample lengths, delay times, and the number of samples in a group are specified from the Sampling Control options.

When satisfactory performance checkout is complete the instrument is ready to use. Proceed to Chapter 5, “Introduction to the Data System.”

Chapter 5
Introduction to the Data System

The LASAIR data system collects and displays particle data. Basic sample report strips can be obtained by means of an external printer. The data system also allows you to configure the LASAIR to monitor the data in formats most suitable to your purposes.

For more comprehensive storage, analysis, monitoring, reporting, and alarms, data can be sent to Facility Net.

Configuration options are accessed from one main setup menu; data are displayed on various types of data screens. To acquaint you with the data system, this chapter describes:

- how to use the keys on the front panel
- three kinds of displays (data, setup, and warnings and alarms)
- what each field contained in those displays represents

To orient you to the system and use of the front panel keys, this chapter also takes you step-by-step through the Instrument Configuration options (option 1 on the Setup Menu). The remainder of the setup options (2 through 8) are described in Chapter 7.

Front Panel Control Keys

The front panel contains the keys used to customize the system, sample, and produce reports. Front panel controls include:

- the Enter key
- the directional keys
- the function keys
- the alphanumeric keypad
- the Help key

Locate the keys using Figure 5-1 on the next page.

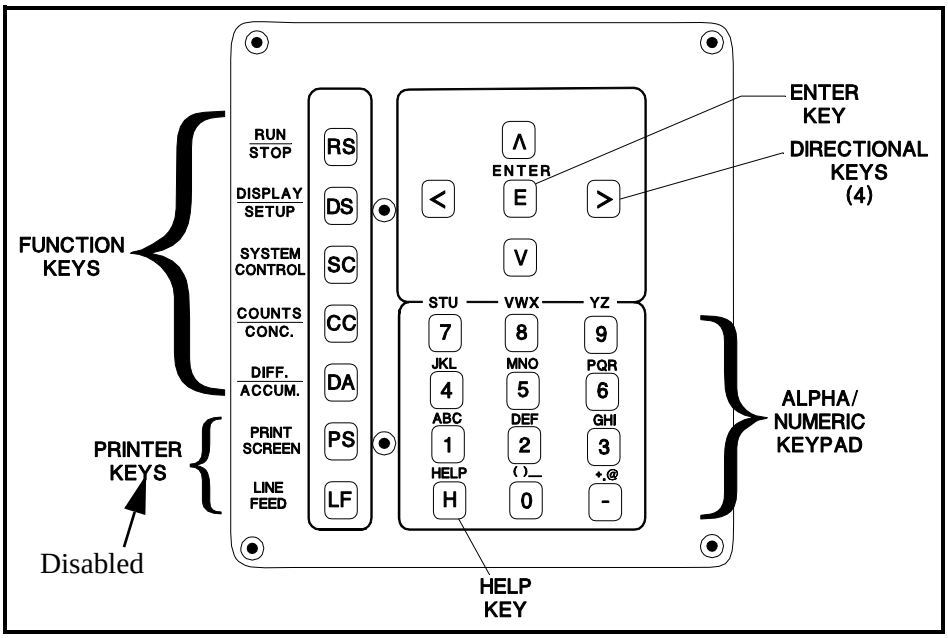


Figure 5-1: Front Control Panel

Display Formats

Because there are countless possible configurations for sampling, there are potentially an endless number of variations on the display. Two elements of all displays are, however, always consistent: the header and footer.

The Display Header

```
SETUP   90/03/27 00:21:35
ID:LASAIR 210  S#: 1       COUNTS
SI:00:01:00 TR:00:00:00  STOPPED
```

Header information appears in the top three lines of each display:

The first line contains:

- the display type
- the date
- the time
- the manifold port number (if applicable)

The second line contains:

- the instrument identifier
- the sample number
- the type of counts represented on the display

The third line contains:

- the sample interval
- the time remaining
- the operating status

A fourth line, which appears on data displays only, contains:

- the time stamp date
- the time stamp time
- a warning or alarm (if applicable)

Display Type — The display type is identified in the upper left corner. On power-up, a data display is always shown. When a data display is shown, the first field in the upper left corner may identify the display type as either:

TABULAR	for a tabular display
PERCENT	for a percent of total counts histogram display
LINEAR	for a linear histogram display
LOG	for a logarithmic histogram display
SERIES	for a time series display
ANALOG	for an analog data display

If the display is a setup screen, the display type shows: **SETUP**

If the display is a system control screen, the display type shows: **SYSCTRL**

The Date — The date is contained in the second field of the first line and is shown in the format: **YY/MM/DD**

The Time — The time, contained in the third field of the first line, is shown in the format: **HH:MM:SS**

Time is shown in a 24-hour format where AM and PM are disregarded and the hours from midnight to 11:00 PM are numbered 00 through 23.

Manifold Port — The last field of the first line identifies the manifold port currently being sampled. If no manifold is connected to the system, this field is blank.

Instrument ID — The first field of the second line, the instrument ID, is user-specified through a setup display.

Sample Number — The second field of the second line contains the sample number (S#). During sampling, the sample number identifies the current sample being taken. When a group sampling is complete, if the data are averaged, the total number of samples in the group is shown. If data are not averaged, the sample number of the displayed data is shown.

Type of Counts — The last field on the second line indicates the type of counts being displayed, either:

COUNTS	for actual counts
N/CF or N/L	for an average concentration
DIFF	for differential counts
ACCUM	for accumulative counts

When a tabular display is shown, the counts are either actual total counts or an average concentration.

Concentration units can be either average counts per cubic foot or counts per liter. See ‘Specifying the Concentration Units’ on page 5-16.

When differential counts are displayed each particle counted is shown in its size class only; when accumulative counts are displayed the data counts appearing in each size class represent all particles detected of that size class and larger. Since both types of counts are displayed on the tabular data display, the designations DIFF and ACCUM are only selectable from the histogram displays, and are selected using the front panel key labeled DIFF/ACCUM.

NOTE: To change the histogram display from CONC to COUNTS or vice versa, see ‘Histograms’ on page 7-4. For a time SERIES or ANALOG data display, no label appears in this field.

Sample Interval — The sample interval (SI:) is user-specified through a setup display.

Time Remaining — The time remaining (TR:) reflects how much time is left in the current sample interval or delay interval between either individual samples or group samplings. If a sample is manually stopped, this field displays the remaining sample time.

Operating Status — The operating status may be either SAMPLING, STOPPED, DELAYING, FINAL, FINALDEL, or MOVING, depending upon whether the instrument is sampling, has been manually stopped, is waiting out a delay period between individual samples, has completed a group of samples, is waiting out a delay period between groups of samples, or is changing manifold ports.

Time Stamp-Date — The time stamp date (shown on data displays only) indicates when the currently displayed data was taken or the date of the last sample. While a sample is running this field will be blank. It is shown in the same format as the current date.

Time Stamp-Time — The time stamp time (shown on data displays only) indicates when the currently displayed data was taken or the ending time of the last sample. While a sample is running this field will be blank. It is shown in the same format as the time of day.

Warnings and Alarms — When a warning or alarm condition is met this field shows either: **WARN** or **ALARM**

The Display Footer

Two important information fields are shown at the bottom of the display:

- the flow rate
- the laser reference voltage

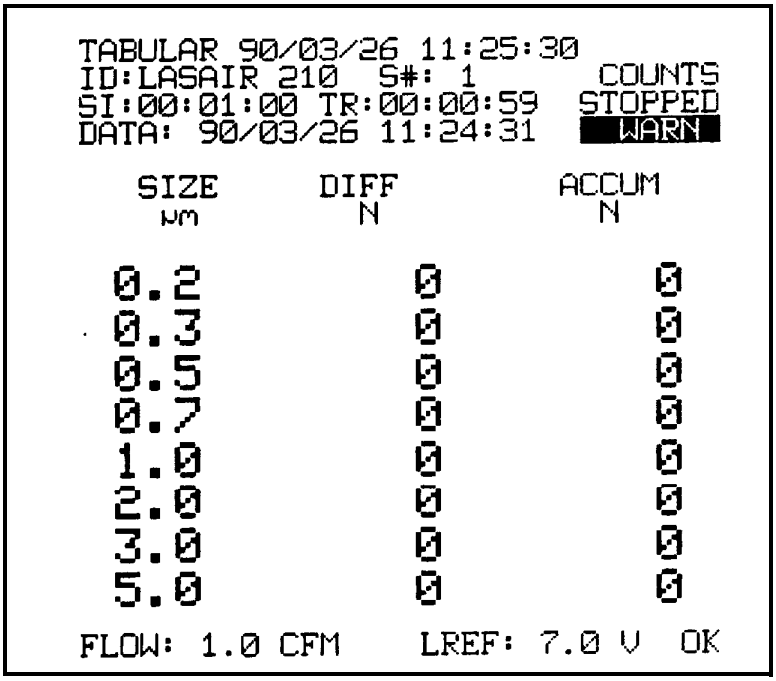
Flow Rate — The flow rate is continuously monitored internally by the LASAIR and is displayed in cubic feet per minute (CFM) or liters per minute (LM). The LASAIR-1004 displays flow rate in cubic centimeters per second (cc/sec.).

Laser Reference Voltage — The laser reference is also continuously monitored. The voltage must be at least 4.5 volts for proper LASAIR operation. Optimal levels are from 7.0 to 9.5 volts.

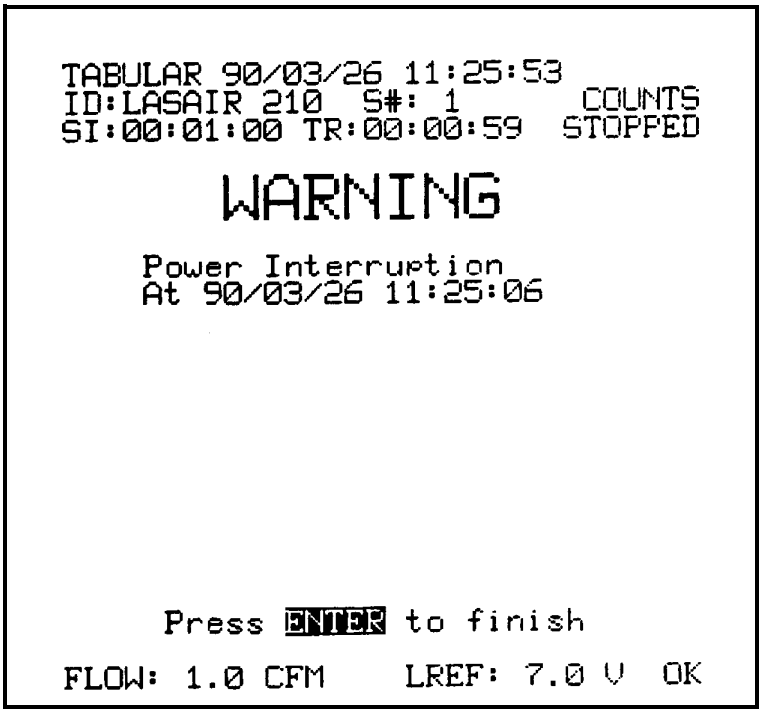
Warning and Alarm Displays

To display a warning flag in the fourth line of the header:

1 Turn the LASAIR off for a few seconds and then turn it back on.



2 Press Enter to display the warning screen.



This particular Power Interruption warning is always issued on power-up. During sampling, warnings may appear for the following reasons:

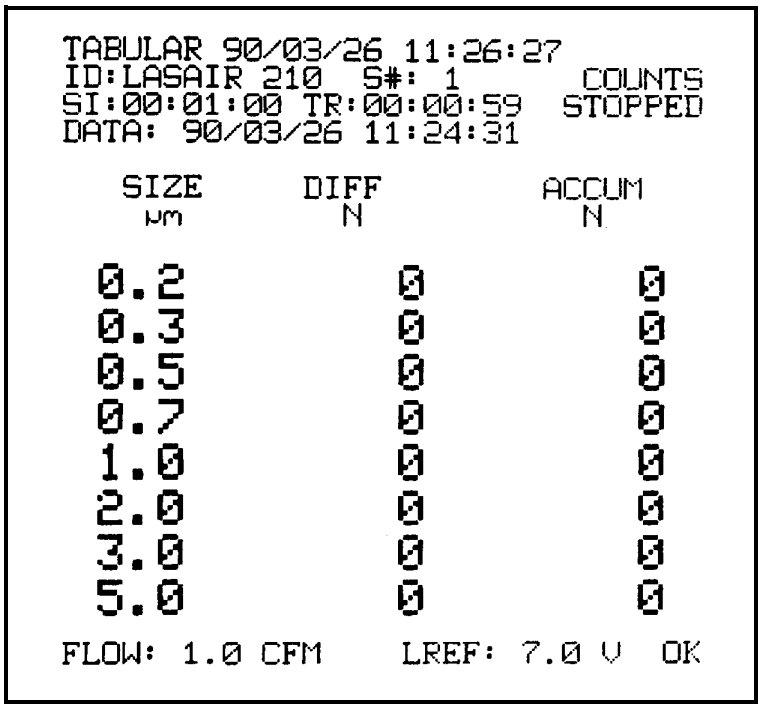
- Low reference voltage
- Low flow rate
- Power interruption
- Non-accumulative counts
- Manifold disconnect
- Manifold time-out

Alarm displays are issued when the LASAIR has met or exceeds a user-specified alarm condition. An example of an alarm condition might be that 1000 particles have been detected in the 2.0 micron size class. Alarm displays are similar in format to the warning displays and give specific information as to the condition causing the alarm.

3 Press the Enter key on the front panel to exit the warning display.

Data Displays

After the Enter key is pressed to clear the warning message, the LASAIR displays a screen similar to the following:



The particle size ranges may vary from those shown here depending on which LASAIR model you have. The display you are now viewing is a tabular data display. There are six types of LASAIR data displays:

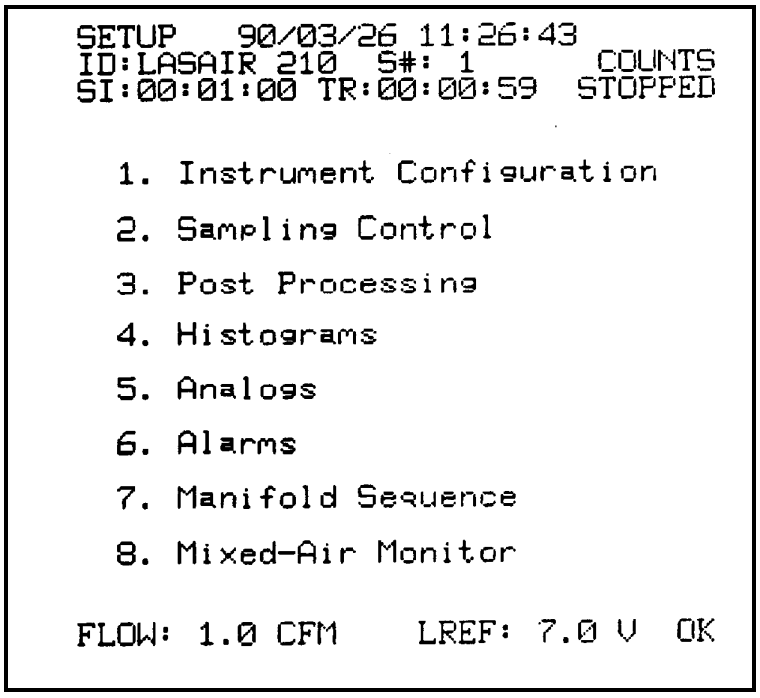
- Tabular
- Percent of total histogram
- Linear histogram
- Logarithmic histogram
- Time series
- Analogs

Sequentially access each of these data displays in this order by pressing the right-arrow directional key five times to arrive at the analogs display; then return to the tabular display by pressing the left-arrow key five times.

When data are being taken, the data screens display real-time data. In other words, data appear on the screen at essentially the same time the particle is detected. Sampling operations can be started and stopped from any data display, setup, or system control screen. Each of the data displays is described in detail in Chapter 8, “Data Display Screens.”

Setup Displays

Press the SETUP\DISPLAY key to toggle from the data display to the Setup Menu.



The LASAIR is customized for sampling using the setup displays. There are eight setup displays accessed from this Setup Menu. Each display allows the operator to customize a different aspect of sampling.

Selecting Options from the Setup Menu

To select an option from the Setup Menu either:

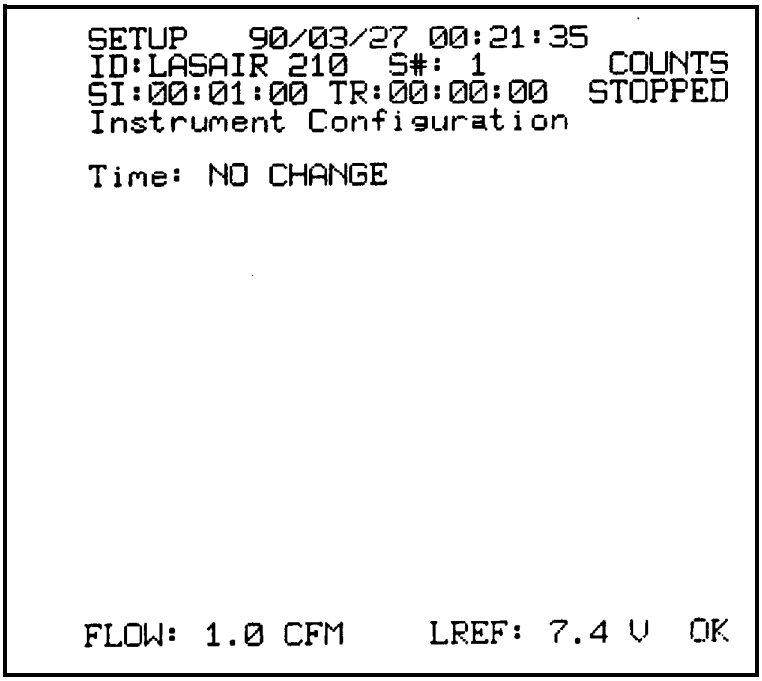
- using the up- and/or down-arrow keys, place the cursor (the flashing light) on the number of the option you want to select and press Enter, or
- press the number of the option you want on the number keypad.

Instrument Configuration

Select Instrument Configuration by using one of these two methods described in the previous paragraph.

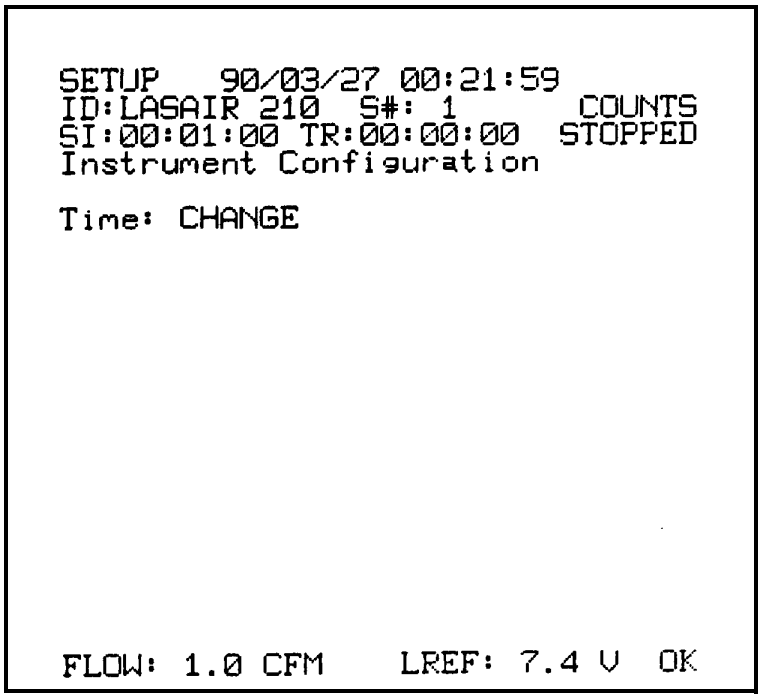
Changing the Time

Use this option to change the time shown in the header. If you elect to make no change in this field, the time shown in the header information remains the same.



To change the time:

1. If the time shown is correct, just press Enter.
2. To change the time, press the right or left-arrow key. The display changes to:

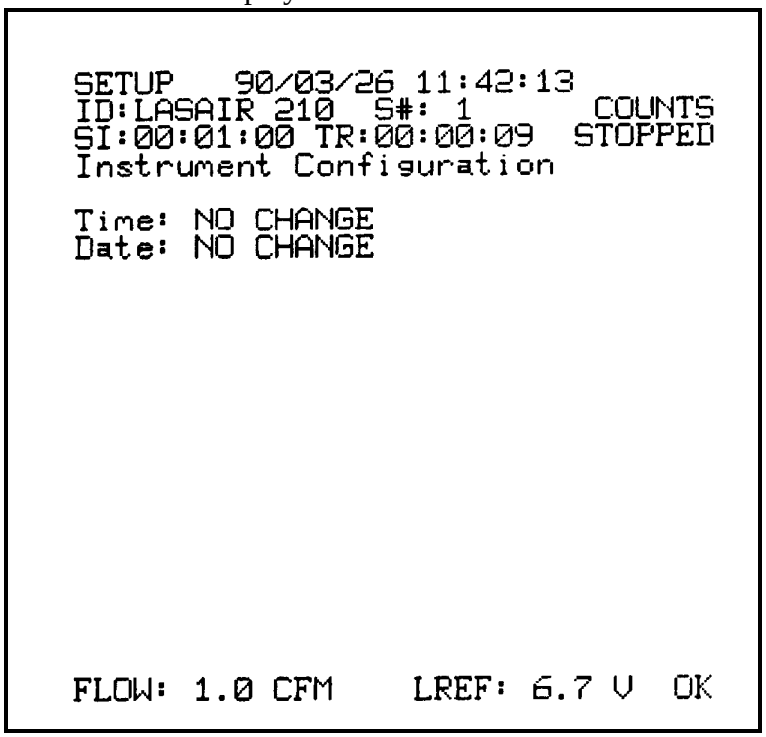


3 Press Enter. The screen shows a time value in the format HH:MM:SS. Use the alphanumeric keypad to enter the appropriate numbers. Enter the time in the 24-hour format where 00:00:00 indicates midnight and 23:00:00 indicates 11:00 PM. After each number is entered, the cursor automatically moves to the next place to the right. If you enter a wrong number, use the directional keys to place the cursor on the incorrect number, and re-enter the correct number.

4 When the correct time is displayed, press Enter to confirm. The display reflects the changed time in the header.

Changing the Date

After the time is changed (or accepted as is) by pressing Enter, the date can be changed. The LASAIR displays:



To accept the date as is, press Enter.

To change the date:

1 Use the directional keys to display: **Date: CHANGE**

2 Press Enter. The display shows the date in the format YY:MM:DD.

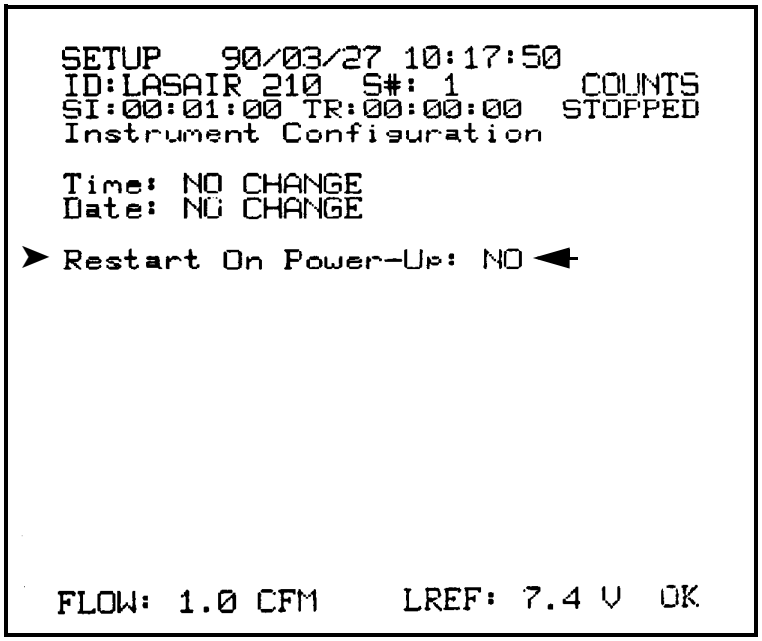
3 Use the alphanumeric keys to enter the correct date. You can also use the directional keys to place the cursor on incorrect numbers and overwrite.

4 When the date is correctly displayed, press Enter to confirm.

The header reflects the corrected date.

Restart on Power-Up

After the date is set by pressing Enter, the screen displays:



This option can be used to ensure that sampling will be resumed in the case of a power failure during unmonitored operation.

If you want the LASAIR to automatically resume counting after the instrument is powered down and up, use the right- or left-arrow key to display YES and press Enter to confirm the selection. If you do not want the counter to automatically begin counting, select NO and press Enter.

NOTE: After a power cycle, a six-second delay occurs before the LASAIR begins sampling.

Low Flow Warnings

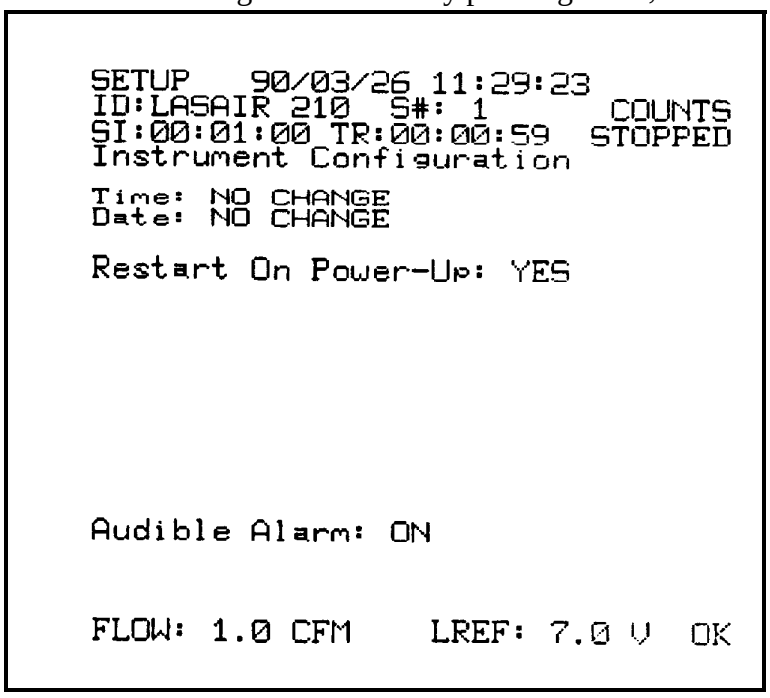
The LASAIR flow rate should be maintained at a minimum flowrate of:

Unit Type	Specified Flow Rate	Minimum Flow Rate
All 1 CFM units	1.0 CFM	0.85 CFM
LASAIR 101	0.10 CFM	0.085 CFM
LASAIR 1001	0.010 CFM	0.0085 CFM
LASAIR 1002	0.0020 CFM	0.0017 CFM
LASAIR 1003	0.0010 CFM	0.00085 CFM
LASAIR 1004	0.280 cc/sec.	0.25 cc/sec.

The LASAIR constantly monitors the flow rate and issues a warning message on the display if the flow rate drops below the minimum allowable.

Turning the Audible Alarm On and Off

After the low flow warning fields are set by pressing Enter, the screen displays:

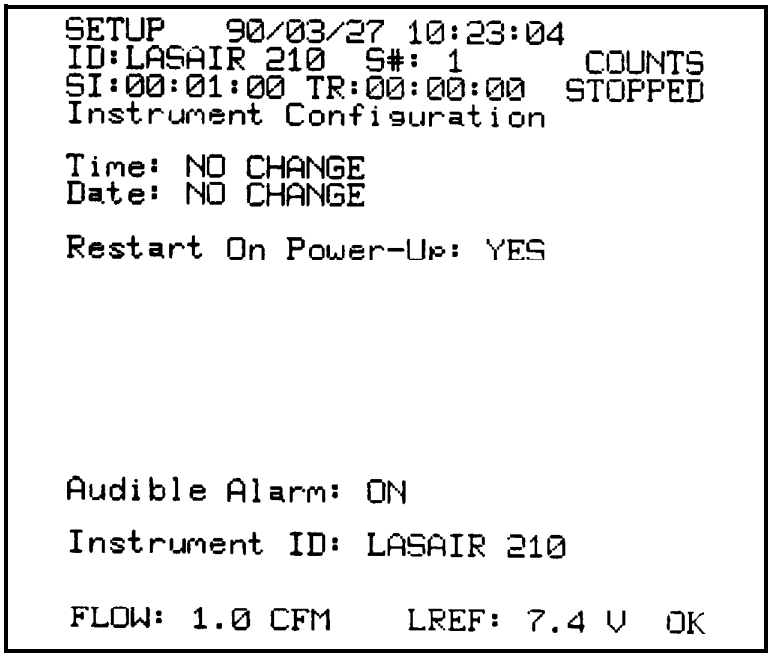


If you elect to have the audible alarm on, the LASAIR sounds a tone when a specified alarm condition is met or a HHIPA count level is reached.

To select either ON or OFF, use the right- and left-arrow keys to display your choice and confirm that choice by pressing Enter.

Entering or Changing the Instrument ID

After the audible alarm is turned on or off, the LASAIR displays:



The ID is shown on printed reports to identify the instrument and can be any combination of numbers, letters, and symbols available on the keypad up to ten characters long.

Using the Alphanumeric Keypad

Notice that each of the keys on the keypad is assigned a number, and two or three letters of the alphabet above the key. With the cursor in the Instrument ID field (or any field that accepts alphanumeric entries), pressing a number key once causes that number to be displayed; pressing the same key twice causes the first letter above that particular key to be displayed. Pressing the same key repeatedly causes the display to cycle through the letters and back to the number associated with that particular key to be displayed. For example:

if you press 7 once, 7 is displayed

if you press 7 twice, S is displayed

if you press 7 three times, T is displayed

if you press 7 four times, U is displayed

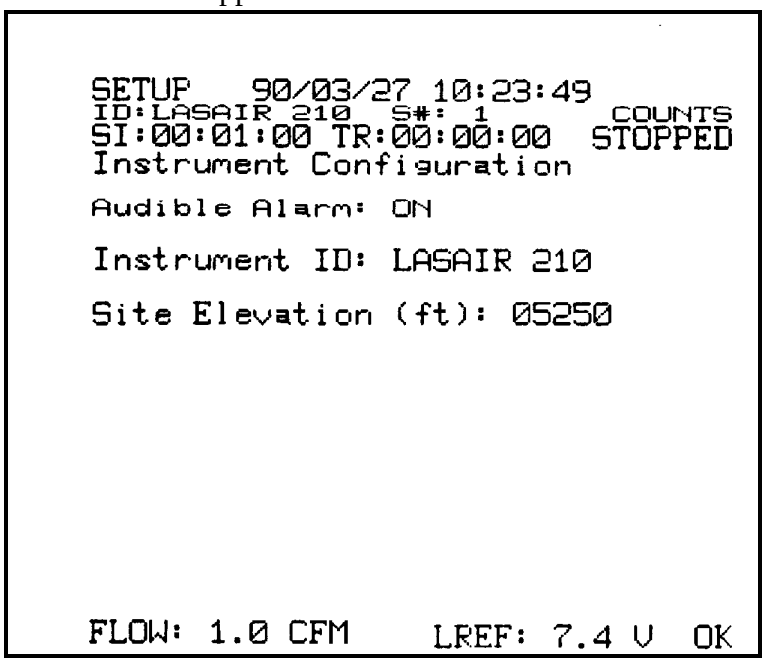
if you press 7 five times, 7 is displayed

When entering the ID, after each number or letter has been correctly entered, use the right- and left-arrow keys to position the cursor at the next position to be entered. To change an incorrect character, use the left- and right-arrow keys to position the cursor over the character and overwrite. To create a space, use the YZ key.

Press the Enter key only after the ID is complete and correct to confirm the entry.

Indicating the Site Elevation

The site elevation field appears as follows:

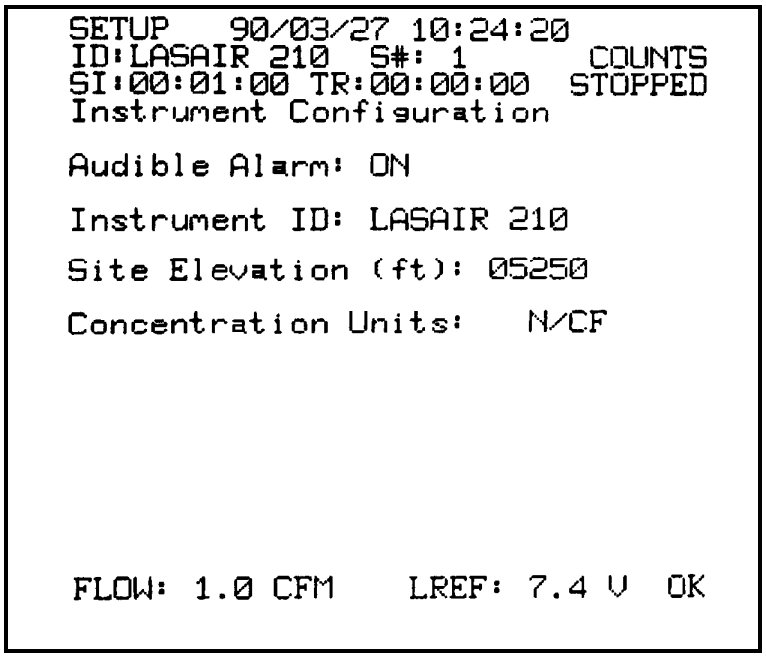


In the site elevation field you may enter up to five numeric characters. Since only numbers are accepted into these fields, it is not necessary to press Enter to move the cursor to the next space. If you wish to alter a particular field, use the right- and left-arrow keys to move the cursor to the number in error and press the correct number.

When the correct elevation is displayed, press Enter to confirm.

Specifying the Concentration Units

After the site elevation has been specified, the monitor displays:



This option defines how data that is represented as a concentration per a given volume is displayed: in either English or metric units.

Using the right- or left-arrow key, select either **N/CF** (number per cubic feet) or **N/L** (number per liter). Press Enter to confirm your selection.

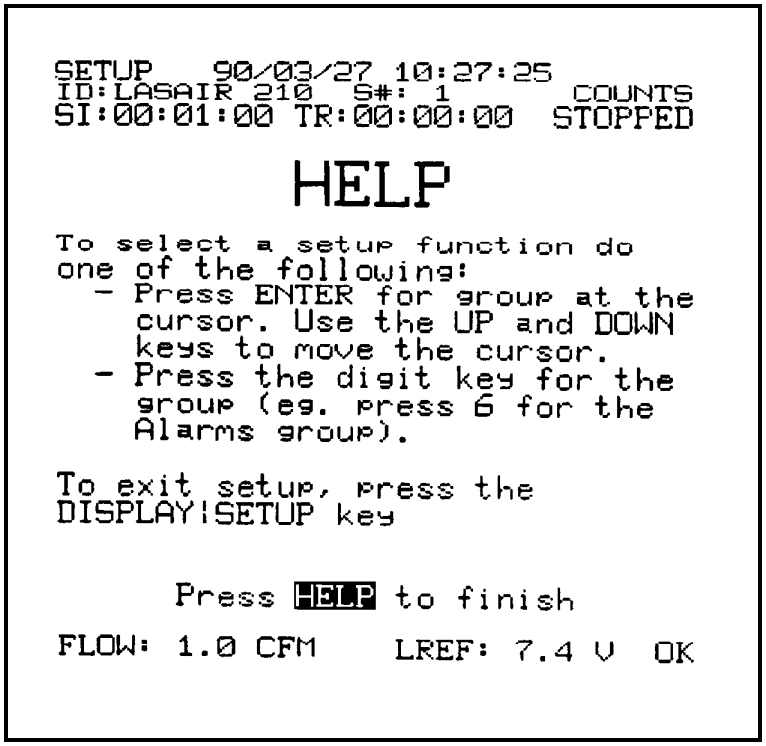
Accessing and Exiting Displays

Notice that after concentration units was entered, the screen returned to the Setup Menu. After the last entry of any setup screen is made, the display returns to the Setup Menu. If you wish to return to the Instrument Configuration options, press Enter again; and to cycle through Instrument Configuration options, press Enter repeatedly. The currently selected options appear in each field; the current date and time are shown in the header. You may stop at any option to change information. You may exit a setup screen at any time by pressing the DISPLAY/SETUP key. While you are in a setup screen, you can use the up- and down-arrow keys to move the cursor up and down the page. The down-arrow key may be used interchangeably with the Enter key. You may exit a setup screen and return to the Setup Menu at any time without altering the current setup field by pressing the SETUP key.

The Help Key

The Help key is located in the lower left corner of the number keypad. Help is available at all times during LASAIR operations.

To display a help screen, press the Help key. From the Setup Menu this help screen appears:


SETUP 90/03/27 10:27:25
ID:LASAIR 210 S#: 1 COUNTS
SI:00:01:00 TR:00:00:00 STOPPED
HELP
To select a setup function do one of the following:
- Press ENTER for group at the cursor. Use the UP and DOWN keys to move the cursor.
- Press the digit key for the group (eg. press 6 for the Alarms group).
To exit setup, press the DISPLAY!SETUP key
Press HELP to finish
FLOW: 1.0 CFM LREF: 7.4 V OK

To exit a Help screen, press the Help key.

Summary of LASAIR Key Use

So far you have used the DISPLAY/SETUP key, the directional keys, the Enter key, and the alphanumeric keypad in a setup screen environment. Knowing how to use these keys allows you to go through the rest of the setup screens to configure the system for operations. Some of these keys, however, when used in other environments, produce different results. Table 5-1 presents a summary of key use.

Table 5-1: LASAIR Front Panel Keys

RUN/STOP	Starts and stops sampling.
DISPLAY/SETUP	Toggles between display and setup screens.
SYSTEM CONTROL	Enters and exits a direct-control operation for external equipment such as aerosol manifolds.
COUNTS/CONC	Toggles between displays of actual counts and concentration data (histograms always show counts data).
DIFF/ACCUM	Toggles between displays of differential data and accumulative data on histograms (tabular displays always show both formats).
PRINT SCREEN	Not an active key (see Chapter 6)
LINE FEED	Not an active key (see Chapter 6)
Up- and Down-Arrow Keys	The down-arrow key performs the same function as the Enter key in most cases. The up-arrow key returns you to the previous option in a setup screen. Both keys modify the Y-scale for the displayed histogram, and enter and exit the phone number help screen from any other help screen.
Left and Right-Arrow Keys	In a display screen cycles through the different kinds of display screens. In a setup or system control screen 1) moves the cursor through an alphanumeric entry field and 2) cycles through the options of a selection field.
Enter	In a setup or system control screen accepts the current field value and moves the cursor to the next field. In a display screen acknowledges warning and alarm messages.

See Chapter 7 for more detailed information on the DIFF/ACCUM, COUNTS/CONC, and RUN/STOP keys. Refer to Chapter 9, “System Control” for information on system control options.

Chapter 6
Report Generation

As the needs of the particle monitoring community have continued to grow, the data analysis and report generation requirements have grown exponentially, until they have exceeded the capability of the LASAIR's on-board computer chip. As a result, the LASAIR analysis and reporting strategy has been updated. Instead of trying to include all possible features in the LASAIR itself, the strategy is now to offer the following two options:

- Obtain basic printer strips directly from the LASAIR by means of an external printer.

  OR

- Conduct all advanced analysis and report generation in a companion or networked PC. This is performed using Facility Net software, an extremely flexible and comprehensive facility management system that includes data storage, analysis, and reporting, in addition to features such as alarms (including automatic e-mails or pages to the concerned personnel), real-time monitoring, etc.

Today, the customer is given the option of receiving either an external printer or a special copy of Facility Net as part of the purchase price of the LASAIR. If the customer desires both, then they can also purchase the external printer. If the customer wants to operate the LASAIR in a network with multiple particle counters or terminal ports, they will need to purchase a more advanced version of Facility Net.

As a result, a number of the original LASAIR controls have been disabled. For example, the Print and Line Advance buttons are no longer active. Likewise, this unit has considerable ability to generate different display formats; as the data retention and analysis needs of users have progressed, it is now more practical to get the data into a computer before generating such reports.

This chapter describes the setup and output of the external printer. For use with Facility Net, the data would be communicated by means of the RS-232 Serial Interface (see Chapter 12). For more information, see the *Facility Net External Printer Software Manual*.

Setting Up the DPU-411 External Printer

The following information deals with using the external printer connected to the LASAIR. The external printer will be either the Seiko DPU-411 or the Seiko DPU-414. The printer will be shipped in its own Seiko packaging. with a communications cable (CD14 #1000003629).

Locate and Save the Printer Operation Manual

The printer Operation Manual is in the same box as the printer.

Ideally, you should read the printer manual before using the printer. However, at a minimum do the following:

1. Read the table of contents so you will know what information is available.
2. Locate and read all hints, notes, and cautions in the manual.
3. Save the manual.

Set the DIP Switches.

The DPU-411 uses mechanical dip switches located on the bottom of the printer. See page 11 of the printer manual.

Set the DIP switches to the following settings:

Table 6-1: Dip Switch 1

Switch No.	Function	ON	OFF
SW 1	Input method setting	Parallel	Serial
SW 2	CR function setting	Carriage return and line feed	Carriage return
SW 3	Print mode setting	Condensed printing (40 columns)	Normal printing (80 columns)
SW 4	Character-set setting	Ordinary settings	Special settings
SW 5	Zero font setting	0	Ø
SW 6-8	International character setting. See the lower table on page 11 of the printer manual.		
SW 6			
SW 7			
SW 8			

Table 6-2: Dip Switch 2

Switch No.	Function	ON	OFF
SW 1	Data bit length setting	Eight bits	Seven bits
SW 2	Parity permission setting	Without	With
SW 3	Parity condition setting	Odd	Even
SW 4-6	Baud rate setting (1200)		
SW 4			
SW 5			
SW 6			

Energize

Connect the AC adapter to the printer and plug the other end of the cable into an appropriate source of power. See section 3.1 on page 7 of the printer operation manual.

NOTE: The printer must be connected and ON when you turn the particle counter on. Otherwise the particle counter will not recognize the existence of the printer.

Loading the Printer Paper

See section 3.2 on page 8 in the printer operation manual.

Connecting the Communications Cable

See section 3-4 on page 13 in the printer operation manual.

Self-Testing

Perform the printer self-test as described on in section 3.5 on page 15 of the printer operation manual.

Printer Output

The following text is an example of the output from the external printer. A description of each line follows this example.

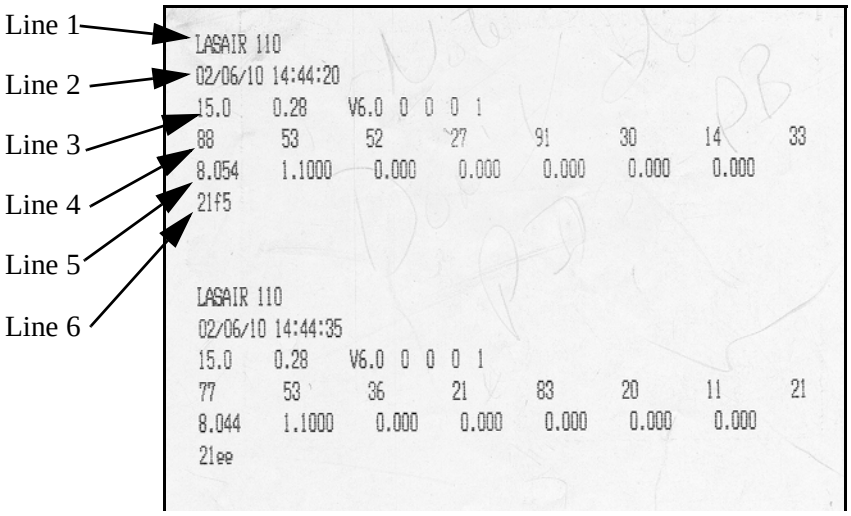


Figure 6-1: Printer SII DPU-411 Print Example

NOTE: The line numbers are for reference only.

Table 6-3: Print-out Legend

Line No	Text or Data	Description
1	LASAIR 110	Sample name/ID
2	02/06/106 14:46:1	Date and time sample was completed. YY/MM/DD Hours:Minute:Seconds
3	15.0 0.28 V6.0 0 0 0 1	
3a	15.0	Time sampled (sec.)
3b	0.28	Volume sampled (cu. ft.)
3c	V6.0	Software version (x.xx)
3d	0	Always zero
3e	0	1 if manifold is searching, 0 if not
3f	0	Manifold position (1-30), 0 if none
3g	1	Sample number, (1-50)
4	78 64 41 16 84 18 4 17	Raw, *differential particle counts per channe*l. (8 values, listed from smallest to largest channel sizes)
5	8.062 1.100 0.000 0.000 0.000 0.000 0.000	
5a	8.062	Laser reference voltage (0-10.000 V)
5b	1.100	Flow rate (CFM)
5c	0.000 0.000 0.000 0.000	Analog device values. 4 values, listed by channel
5d	0.000	Always 0.000
6	21f1	Checksum

Setting Up the DPU-414 External Printer

The external printer will be either the Seiko DPU-411 or the Seiko DPU-414. The printer will be shipped in its own Seiko packaging. A communications cable will be included (CD14 #1000003629).

Locate and save the printer operation manual

The printer Operation Manual is in the same box as the printer.

Ideally, you should read the manual before using the printer. However, at a minimum do the following:

1. Read the table of contents so you will know what information is available.
2. Locate and read all hints, notes, and cautions in the manual.
3. Save the manual.

Energize the Printer using the AC Adapter

See section 2.1 on page 12 of the printer manual for instructions.

NOTE: The printer must be connected and ON when you turn the particle counter on. Otherwise the particle counter will not recognize the existence of the printer.

Load Paper

The standard printer shipment includes one roll of thermal paper. See section 2.2 on page 13 of the printer manual for loading instructions.

Complete the DIP Switch Settings

The DPU-414's dip switches are set by means of internal software. See pages 15-19 in the printer manual.

Set the dip switches to match the grey cells by pressing either the ON LINE or FEED control button:

Table 6-4: Software Dip Switch SW1

		Printer Control Button	
Switch No.	**Function**	**ON LINE**	**FEED**
1	Input Method	Parallel	Serial
2	Printing Speed	High	Low
3	Auto Loading	On	OFF
4	Auto LF (Line Feed)	Carriage return	Carriage return and line feed
5	DIP SW Setting Command	Enable	Disable
6-8	Print Density. See the lower table on the printer manual's page 17.		
6	100%		
7			
8			

Table 6-5: Software Dip Switch SW2

		Printer Control Button	
Switch No.	**Function**	**ON LINE**	**FEED**
1	Print mode	Condensed printing (40 Columns)	Normal printing (80 Columns)
2	User-defined characters back-up	On	Off
3	Character type	Ordinary characters	Special characters
4	Zero font	0	Ø
5-8	International character set. See lower table on page 18 of the printer manual.		
5			
6			
7			
8			

Table 6-6: Software Dip SW3

		Printer Control Button	
Switch No.	**Function**	**ON**	**OFF**
1	Data bit length	Eight bits	Seven bits
2	Parity permission	Without (no)	With
3	Parity condition	Odd	Even
4	Flow control		XON/XOFF
Baud Rate (1200) switches 5-8			
5			
6			
7			
8			

Connecting the Printer to the LASAIR

Connect the printer to the computer with the provided RS-232 communications cable. See section 2.5 on page 20 of the printer manual.

Test Print

Verify that your printer is operating correctly by producing a test print. See section 2.6 on page 22 of your printer manual.

Printer Output

The model 414 printer's output is the same as model 411. See page 6-4.

Chapter 7
Setup Menu and Setup Displays

The LASAIR can be configured to:

- run individual samples or groups of samples of any duration, either once or repeatedly
- display actual counts or averaged data which include all data taken or exclude questionable samples
- accept and report data from analog devices
- display alarm condition information
- execute a manifold port sequence

NOTE: Use either an external printer or use Facility Net to print reports.

The instrument is configured through the Setup Menu options. In this chapter, Setup Menu options (2 through 8) are covered in detail:

- Sampling Control
- Post Processing[1]
- Histograms[1]
- Analogs[1]
- Alarms[1]
- Manifold Sequence

"Instrument Configuration" on page 5-9 discussed the configuration items under Option 1.

1. Use either an external printer or Facility Net to print reports. Use Facility Net for the data described in this chapter under Post Processing, Histograms, Analogs, and Alarms. Facility Net can print data or conditions generated by LASAIR, such as: actual or averaged counts, analog data, and condition information. (See Chapter 6.)

Use the LASAIR front panel keys in the manner described in Chapter 5 to select each option and make appropriate entries. See Table 5-1, “LASAIR Front Panel Keys,” on page 5-18.

NOTE: Most setup options can be accessed at any time and can be changed at any time; however, some setup options cannot be changed while a sampling operation is in progress (for example, sample length).

Sampling Control

Use option 2 on the Setup Menu to configure the LASAIR to take a single sample or a group of up to 50 samples, either once or repeatedly. Specify the sample length and, if you are running a group of samples, a delay time between samples.

Sample Length

The Sample Length is the duration of each individual sample. Sample Length is used whether you elect to run a single sample or a group of samples. To change or enter a sample length, use the number keypad. If you enter a number in error, use the right- and left-arrow keys to position the cursor, then overwrite the incorrect number. Press Enter to confirm.

The Sample Length is specified in the form: **`HH:MM:SS`**

The minimum sample length is 6 seconds.

of Samples in Group

Use this field to indicate how many samples are to be taken in this particular group sampling. To designate a single sample, enter 01. The LASAIR accepts up to 50 samples in a group.

Sample Delay Length — This option appears only if you entered a number greater than 1 for the previous option. The LASAIR prompts to enter a Sample Delay Length in the form: **`HH:MM:SS`**

The Sample Delay Length is the time between the end of one sample and the beginning of the next. In general, the object of a delay time is to set sampling at regular intervals. If the Sample Delay length is set to zero and continuous or multiple samples are being taken, upon completion of a sample the LASAIR immediately proceeds with the next sample.

To enter the Sample Delay Length, use the alphanumeric keypad and the right- and left-arrow keys to reposition the cursor, if necessary. When the correct time is shown, press Enter to confirm.

Continuously Repeat Group

If you select **NO** for this option, LASAIR completes the number of samples in the group (from 1 to 50) and ends sampling.

If you select **YES** for this option, LASAIR completes one group of samples, and then (after the specified Group Delay Length) begins another group sampling. The instrument continues to sample in this manner until you manually end sampling by pressing the RUN/STOP key.

Use the right- and left-arrow keys to toggle between **YES** and **NO**. When the appropriate designation is shown, press Enter to confirm your selection.

Group Delay Length — This option only appears if you selected YES for the previous option. The Group Delay Length is the time between the end of the last sample of a group and the beginning of the first sample of the next group. It is specified in the form: **HH:MM:SS**

Any Group Delay Length can be specified; if a zero delay is entered, sampling begins immediately after the prior group sampling is finished.

Use the alphanumeric keypad to enter the group delay and press Enter to confirm the entry.

Print on Each Sample

To print on each sample use either the external printer (see Chapter 6) or configure Facility Net to generate the print jobs. See the *Facility Net External Printer Software Manual*.

Post Processing

The selections made from Post Processing (option 3 on the Setup Menu) determine how the data collected from groups of samples are handled for display. After a group of samples has been taken, changes in Post Processing affect the data display. Group size must be greater than 1 to access the Post Processing options.

Final Display

Using this option you can designate the final displays following group samplings to report either a single sample or the averaged data for each group of samples. Use the right- or left-arrow key to display your selection and press Enter to confirm.

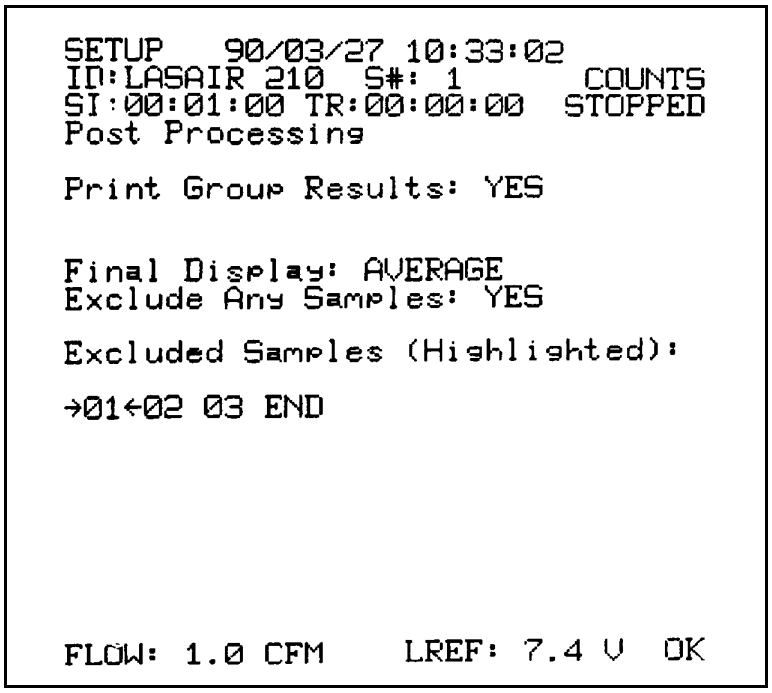
Sample Number — This option only appears if the group number is greater than 1 and you selected: **Final Display: SINGLE**

Select the sample number to be displayed at the end of group sampling.

Exclude Any Samples — This option only appears if the group number is greater than 1 and you selected: **`Final Display: AVERAGE`**

Use this option to exclude any questionable samples from the calculation of averaged data. Sample data may be excluded after a group sampling has been taken to change the averaged data. When you return to the data display the data average will reflect the new exclusion set. If you select YES, an exclusion list appears.

Excluded Samples — The LASAIR displays a list of sample numbers. Use it to indicate which samples are to be excluded from the averaged data. To exclude a sample, move the double arrows to surround the sample to be excluded and press Enter to highlight the number. Highlighted numbers will be excluded from the calculations. In the following example, sample 01 has been selected for exclusion.



To include a sample that was previously highlighted, move the double arrows to surround the sample and press Enter. The highlighting will be removed.

When you have highlighted every sample number to be excluded, move the double arrows to END and press Enter to confirm your selections.

Histograms

The histogram data displays can be dynamically changed while they are being viewed. The vertical scale may be changed in increments using the up- and down-arrow keys to view more or less of the “window” of data, allowing you to scale the histograms to see small changes more clearly, or view peaks that might

otherwise be off the display. Selections made from the Histograms option (option 4 on the Setup Menu) determine how each histogram display will initially appear and the vertical scale increment by which each display will be affected each time an up- or down-arrow key is pressed.

Percent of Total Maximum

This option indicates what the total percentage displayed on the vertical scale will be when you initially view the Percent of Total histogram.

Use the alphanumeric keypad and right- and left-arrow keys to indicate the maximum percent viewed. The minimum allowable value is 5%. The maximum allowable is 100%. Press Enter to confirm.

Percent of Total Increment

While the Percent of Total histogram is being displayed you may press the up- and down-arrow keys to dynamically increase or decrease the total percent shown by the vertical scale. Use this option to specify the increment by which the vertical scale will be increased or decreased each time you press the up- or down-arrow key.

Use the alphanumeric keypad and right- and left-arrow keys to indicate the increment. The maximum is 50%; the minimum is 1%. Press Enter to confirm.

Linear Maximum

This option indicates what the maximum number of counts displayed on the vertical scale will be when you initially view the linear histogram.

Use the alphanumeric keypad and right- and left-arrow keys to indicate the maximum number viewed. You can select from 5 to 1000000. Press Enter to confirm.

Linear Increment

While the Linear histogram is being displayed you may press the up- and down-arrow keys to either increase or decrease the total number shown on the vertical scale. Use this option to specify the increment by which the total number of counts displayed will be increased or decreased.

Use the alphanumeric keypad and right- and left-arrow keys to indicate the increment. The minimum is 1 The maximum is 500000. Press Enter to confirm.

Logarithmic Maximum

This option indicates what the maximum number of counts displayed on the vertical scale will be when you initially view the logarithmic histogram. Three decades of log values are displayed on a screen. If the lowest value of the three decades is less than one, a pseudo-zero value is used for the minimum.

Use the left- and right-arrow keys to select the maximum value. You can select from 100 to 1000000. Press Enter to confirm.

Time Series Maximum

This option indicates what the maximum number of counts displayed on the vertical scale will be when you initially view the logarithmic time series histogram. Three decades of log values are displayed on a screen.

Use the left- and right-arrow keys to select the maximum value. You can select from 100 to 1000000. Press Enter to confirm.

Time Series Channel

Use this option to select the particle size to be monitored during this sampling. If you want to conduct a time series sampling, from the Sampling Control options, select:

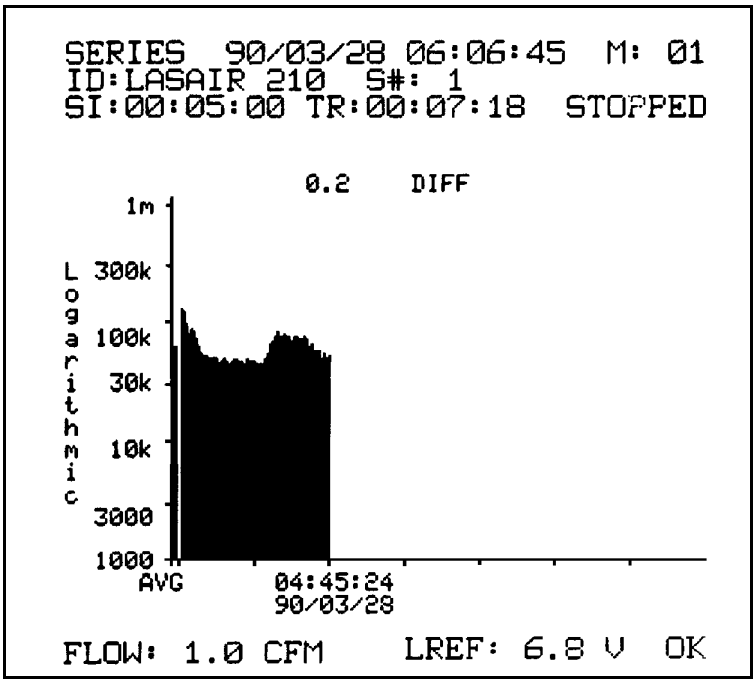
```
# of Samples in Group: 01
Continuously Repeat Group: YES
```

Data for time series samplings is only taken from single sample groups in continuous mode.

Differential or Accumulative

Use this option to select the form in which the time series sampled data gathered from the selected channel are to be displayed.

Time series data are displayed in this format:



Analogs

The LASAIR can handle up to four analog inputs from sensors with outputs from 4 to 20 milliamps. These sensors may be temperature and humidity probes purchased from Particle Measuring Systems, or other types of sensors, as long as they adhere to the 4-20 milliamp requirement. The analog input port is located on the back of the instrument and is labeled ANALOG INPUT.

In order for the LASAIR to properly interpret the information being sent from these various analog devices, analog setup information must be entered by means of this option (5 on the Setup Menu).

Analog Device #1 Enabled

The attached analog devices are continuously sending signals to the LASAIR; however, the data are not monitored by the instrument unless YES is selected in this field. To change from NO to YES and vice versa, use the right- or left-arrow key to toggle to your choice and press Enter to confirm your selection.

If you select NO for this particular device, the next option displayed is the Enable option for the next device number.

If you select YES for this device, the LASAIR requests additional information about the device.

Device ID — This field is eight characters long. You may enter any combination of alphanumeric characters using the keypad and the right- and left-arrow keys to position the cursor. When the ID is correctly shown, press Enter to confirm and move on to the next option. This ID is reflected on displays and printed reports.

Units — Use this six-character field to indicate an alphanumeric label for the units being reported. You may, for example, enter "PCT" for percent (humidity).

4 mA Value — This entry tells the LASAIR what 4 milliamps of input equals in analog device units. Enter the 4-milliamp value for this analog device using the alphanumeric keypad and the right- and left-arrow keys. Press Enter to confirm.

20 mA Value — This entry tells the LASAIR what 20 milliamps of input equals in analog device units. Enter the 20-milliamp value for this analog device using the alphanumeric keypad and the right- and left-arrow keys. Press Enter to confirm.

Average Reading Over Sample — If you select YES, the data reported on-screen is averaged. In other words, during analog data-taking operations, the data are averaged. If you select NO, the data always reflects the data being received by the LASAIR at that time. Analog data displayed while not sampling is always instantaneous.

Analog Device #2-4 Enabled

See "Analog Device #1 Enabled" on page 7-7. Options for devices #2, #3, and #4 are identical to those for device #1.

Alarms

This option (6 on the Setup Menu) sets the alarm parameters and enables alarms for:

- particle counts
- analog devices

Particle counts can be monitored on each port of an attached aerosol manifold or the counter. When an alarm is enabled, and the alarm conditions are met or exceeded, an alarm message is displayed on the screen. You may use Facility Net to have these alarm message displays shown on the Facility Net host PC or printed to record alarm conditions.

Manifold Port

This field appears only if a manifold is connected to the LASAIR and you have enabled manifold sequencing. You may elect to monitor counts on any or all ports of the manifold. To set up the LASAIR to monitor counts on a specific port, enter the port number in this field and press the Enter key to confirm. Use the options below to specify the alarm parameters for this port.

After one port alarm has been set up, return to this screen to configure the alarm parameters for the next port, and so on.

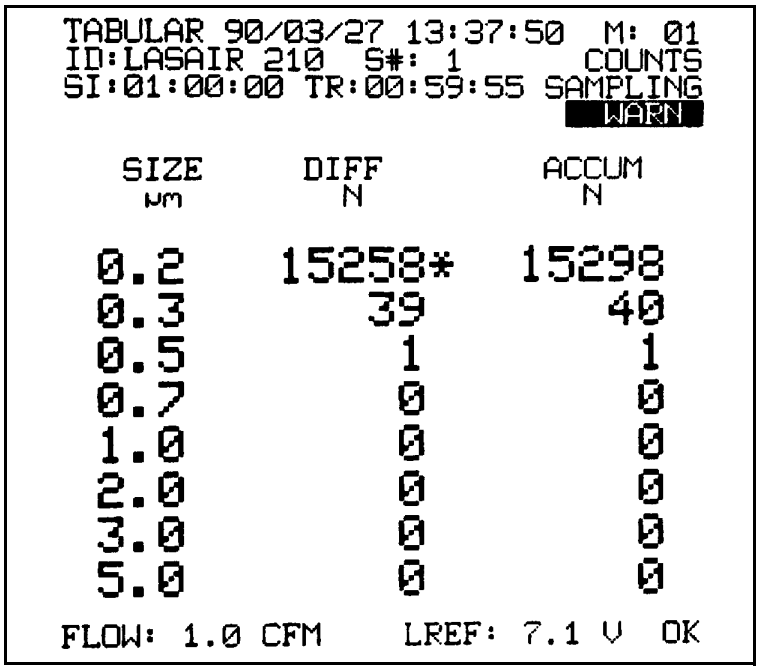
Count Alarm Enabled

If no aerosol manifold is connected to the LASAIR, this option and the following options are used to define alarm conditions for the counter. If an aerosol manifold is connected to the LASAIR, this option and the following options are used to define alarm conditions for each individual port on the manifold.

Use Facility Net to print alarm messages, or to page or E-mail the proper contact person.

Size — Use the right- and left-arrow keys to cycle through the size classes. The class selected is monitored for the alarming condition defined by these options. The LASAIR displays as options only those classes specific to your instrument.

When, during sampling, an alarm condition is met for this size class, an asterisk (*) appears next to the counts that signalled the alarm condition in the indicated size class. The asterisk remains until the next sample starts. In the following example, an alarm is signalled in the 0.2 size class.



Differential or Accumulative — Indicate whether the LASAIR is to monitor differential or accumulative counts for the alarm condition.

Counts or Concentration — Indicate whether the number of counts signalling the alarm condition is to be actual counts or a volumetric concentration value.

Value — Enter the number of counts that constitute an alarm condition. Use the alphanumeric keypad and right- and left-arrow keys to overwrite errors. Press Enter to confirm.

Print on Count Alarm — If you want a printout of each alarm condition, you must use Facility Net to create the print job.

Analog Device

This option appears only if you have enabled one or more analog devices from Analogs (option 5) on the Setup Menu. Use this option to specify the analog device to be monitored for the alarm conditions you have set under Count Alarm Enabled. The LASAIR allows you to select only one of the devices enabled in the Analog setup screen. Use the right- or left-arrow key to select a device number and press Enter to confirm your selection.

Alarm Enabled

Select YES if you wish to set parameters for an alarm condition for the selected analog device. Select NO if no alarm condition is to be noted.

If you select YES, you are presented with options for setting the alarm parameters. When the alarm condition is met, a message appears on the screen.

Maximum Value — Use this field to indicate the maximum allowable value. If the input from analog device 1 exceeds this value, an alarm display appears. The unit of measure for this analog input (which was entered under ANALOGS) is noted on the screen in parentheses.

Minimum Value — In this field, enter the lower limit of the acceptable range from analog device #1. If the input from analog 1 falls below this value, an alarm display appears. The unit of measure for this analog input (which was entered under ANALOGS) is noted on the screen in parentheses.

Print on Alarm — If a printed report is to be generated each time an alarm condition occurs, you must use Facility Net.

Manifold Sequence

This option (7 on the Setup Menu) enables the manifold. The LASAIR automatically detects the type of manifold attached and an identifier appears on the first line:

Manifold Type: AM-12

or

Manifold Type: AM-24

or

Manifold Type: AM-30

NOTE: Aerosol manifolds (AM) are sold as options to the LASAIR. If you do not have an aerosol manifold installed with the Aerosol Manifold Interface (AMI), you cannot access these options.

Use With the Aerosol Manifold II (AM II)

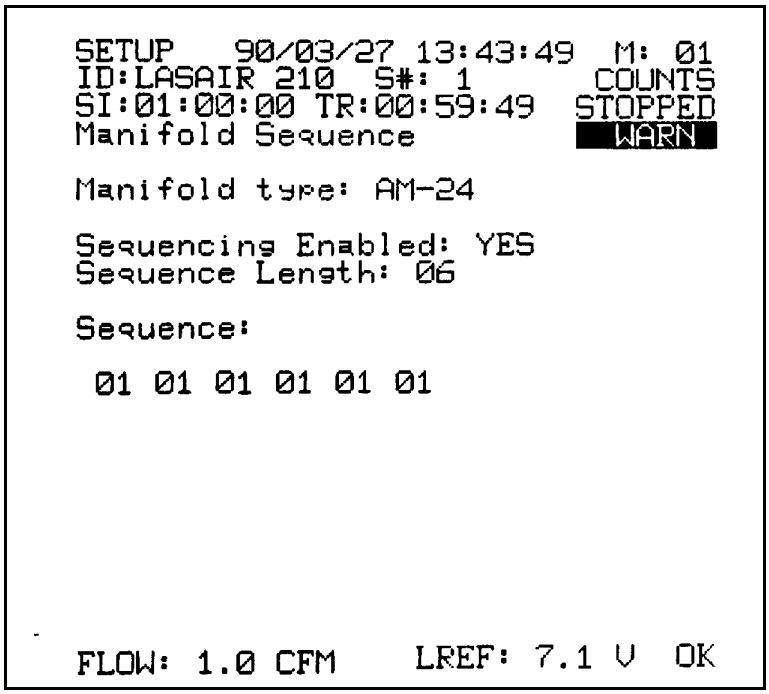
The new AM II manifolds can be use with the LASAIR, but only by having the AM II emulate the AM-12/24/30. In this event, the AMI is still required. For more information see the *AM II 16/32 Aerosol Manifold Owner's Manual*.

Sequencing Enabled

If you want to specify a sequence of port sampling, select YES; if not, select NO using the right- or left-arrow keys. Press Enter to confirm.

Sequence Length — This option indicates how many numbers are to be in the sequence. You may specify up to 72 (even though there are fewer ports). You must enter at least 01 in this field. Use the alphanumeric keypad to specify a number and press Enter to confirm.

Sequence — The LASAIR automatically presents the number of entries that you specified for Sequence Length in double digits. For example, if you specified a sequence length of 06, the LASAIR displays:



Use the alphanumeric keypad to enter the desired sequence of port sampling. Numbers may be specified in any order: repeating, increasing order, decreasing, or random. After each entry is made, press the Enter key to move to the next field. After the last entry is made, the display returns to the setup screen.

Notice that the current manifold position is displayed in the upper right corner of the screen (M:01).

Mixed-Air Monitor

Use this option (8 on the Setup Menu) to set the parameters for Mixed Air Sampling.

NOTE: The mixed air capability is sold as an option to the LASAIR. If you do not have a Mixed Air Sample Adaptor or DDAM-16 installed, you cannot access these options.

Mixed air monitoring can be accomplished with a Mixed Air Sample Adaptor (MASA), a LASAIR and an AM-12, AM-24 or AM-30. The MASA obtains a sample that is a mixture of all the used ports of the manifold, delivers it to the mixed air sampler, and the mixed air sampler sends the particle data to the LASAIR. The LASAIR monitors this information for high particle counts and displays the counts on the Analog display. When a mixed air alarm condition occurs, the manifold goes into a "search" mode, sequentially sampling each port in the order specified under option 7, Manifold Sequence, to find the port causing the alarm condition. In this manner, high particle count conditions can be detected and traced within a very short period of time.

Mixed Air Alarm Enabled

If you want to use the mixed air options, select YES; if not, select NO. Press Enter to confirm.

Mixed Value — Enter the number of total counts detected by the mixed sample that will signal an alarm condition. This number should reflect the maximum number of particles seen in the Sample Length specified under option 2, Sampling Control. The value entered here should be smaller than the value entered in the Search Value field by the ratio of the sample flow rate/mixed flow rate. This number is affected by the number of ports that are plugged as well as other factors which are difficult to predict. The best way to determine the ratios is by either:

- measuring the actual flows in the sample lines and the mixed air line, or
- by observing the ratio between the counts in a given port and the counts in the mixed air line when the other ports are sampling clean air.

Enter the total counts (up to six digits) and press Enter to confirm.

Search Value

This field and the Search Sample Length field define the alarm conditions for the data collected while the manifold is in Search mode.

Enter the maximum allowable total counts per port (to be used to identify the sample port which caused the alarm condition) for the time to be entered for the Search Sample Length.

Search Sample Length — Enter the amount of time in hours:minutes:seconds to be spent sampling each port when the manifold is searching for the port that caused the mixed air alarm condition.

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Chapter 8
Data Display Screens

In the previous chapter, the Setup Menu and associated setup screens were addressed. Their purpose is to configure the LASAIR for sampling. The data screens, on the other hand, monitor data-taking during sampling. Use Facility Net to generate these reports (see Chapter 6).

To access a data display from a setup display, press the DISPLAY/SETUP key. There are six types of LASAIR data displays:

- Tabular
- Percent of total histogram
- Linear histogram
- Logarithmic histogram
- Time series
- Analogs

You can sequentially access each of these data displays in this order by repeatedly pressing the right-arrow or in the reverse order by pressing the left-arrow directional key.

This chapter describes:

- the fields appearing in data screen headers which are pertinent to data screens
- each of the six data display formats

The Data Display Header

The information fields in the first three lines of the data display header are identical to those in the setup display header except that, in a data display, instead of saying SETUP, the identifier in the upper left corner tells what type of data display you are viewing, either: TABULAR, PERCENT, LINEAR, LOG, SERIES, or ANALOGS. The date, time, ID, and sample interval (SI) fields are all specified by the user in the setup screens. The remaining header items are significant in the data screen and are described in the following paragraphs.

TR (Time Remaining)

Time remaining is updated each second and indicates how much time is left in the sample interval or the delay, whichever is applicable.

S# (Sample Number)

The sample number identifies the current sample number of the group being taken. For example, a 2 in this field means that sample number 2 of a group of any number of total samples is currently being taken.

When a group sampling is completed (and for which Final Display: AVERAGE is selected), this field shows the total number of samples in the group. For example, when a group of 10 samples has been completed, the screen shows:

1→10

If any of the samples from this group has been excluded from the averaged data (using the Post Processing options), an E appears indicating that one or more samples have been excluded from the final calculation of sampled data:

1→10 E

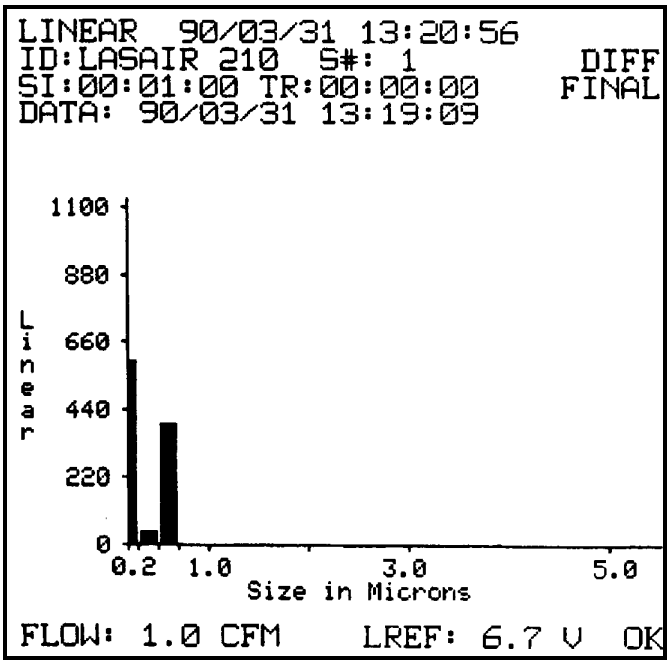
The final display for a single sample shows the selected sample number in this field.

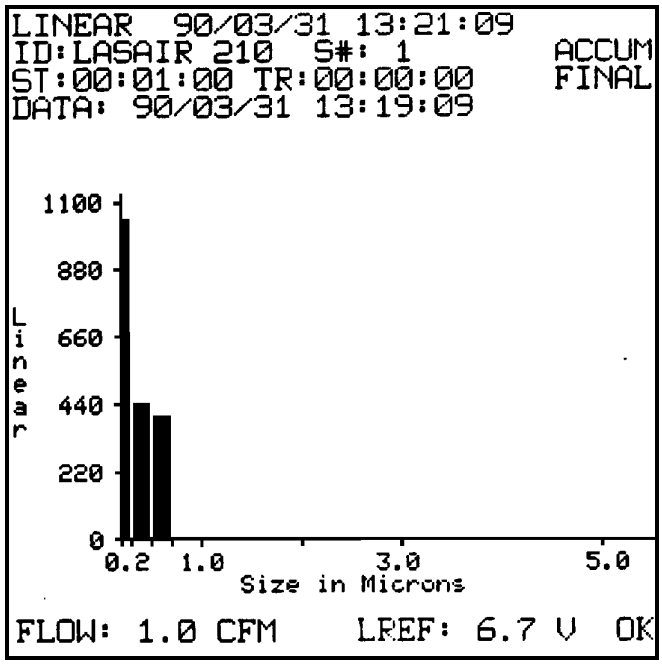
DIFF/ACCUM/ COUNTS/ CONC (N/L or N/CF)/ SEARCHING

These indicators appear in the last field of the second line and identify the type of counts currently being represented. DIFF/ACCUM indicates how the particle data are displayed on histograms: as differential or accumulative.

DIFF indicates that differential counts are being displayed and each particle is being counted in its size class only.

ACCUM indicates that accumulative counts are being displayed and the data appearing in each size class represents all particles detected of that size class and larger. For example, in the following figure 601 1.0 micron particles were detected; however, in one example the data is differential and in the other it is accumulative. Toggle from DIFF to ACCUM and vice versa using the DIFF/ ACCUM key.





COUNTS/ N/L / N/CF indicates whether the actual number of raw counts is displayed or the concentration of particles per cubic foot or liter is displayed on tabular data displays. When N/L or N/CF is selected, the raw counts are normalized, or divided by the sample volume, to show a representative number of particles per cubic foot or liter of sampled air. Both actual counts and normalized counts can be displayed differentially or accumulative.

SEARCHING is displayed when the mixed-air manifold is searching for the port(s) which caused an alarm condition.

STOPPED/ SAMPLING/DELAYING/FINAL/FINALDEL/ MOVING

These indicators appear in the last field of the third line and monitor the current sampling status.STOPPED indicates that the operator has manually stopped the sampling process by pressing the RUN/STOP key. The TR field shows the time remaining in the sample interval.

SAMPLING indicates that the operator has begun data-taking by pressing the RUN/STOP key and data-taking is currently in progress. The time remaining (TR) counts down the time left in the sample interval (SI). The sample number is reflected in the S# field.

DELAYING indicates that the LASAIR is in the delay time between individual samples within a group and is counting down the delay interval (also reflected in TR) before beginning the next sample.

FINAL indicates that the LASAIR has completed a single sample or a group of samples in non-continuous mode.

FINALDEL indicates that the LASAIR is in continuous mode, has completed a group sampling, and is counting down the delay time between groups of samples. The time remaining in the delay is shown in the TR field. The DATA field reflects the date and time the group sampling was completed for reporting. The S# field shows the completion of a group of X samples by displaying DATA: 1- X (for averaged final data) or sample number (for single final display).

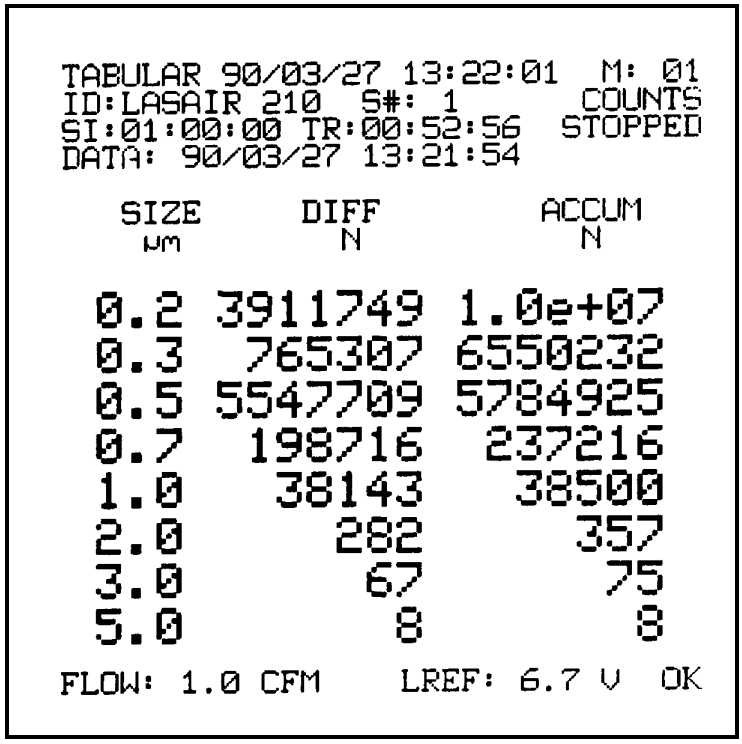
MOVING indicates that the manifold is moving between ports. There is a five second dead time after a move.

DATA

The fourth line of the data display reflects the date and time of the most recently completed sample interval or group sampling. The date and time stamp is given for the purpose of reporting in this format: **YY/MM/DD HH:MM:SS**

Tabular Data Display

A typical tabular display appears as follows:

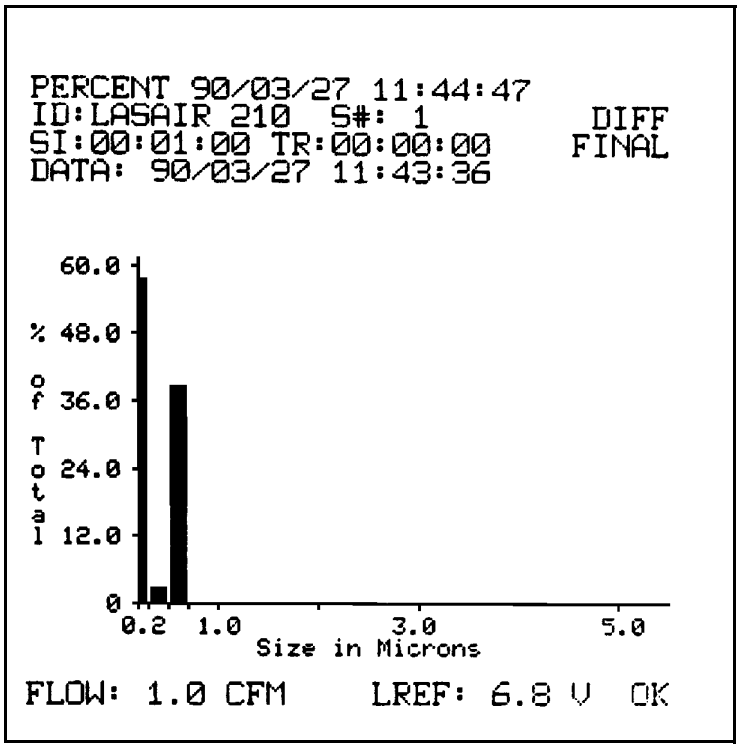


Size classes are shown at the left. A size class is defined by a range of particle size, for example: 0.2 to 0.3 microns, 0.3 to 0.5 microns, and so on. The size classes reported by your system depend upon which LASAIR model you have. The first column of data represents differential counts; the column to the right shows accumulative counts. Notice that when counts reach 10,000,000, the number is displayed in scientific notation. For example, the number 10,461,081 is expressed as 1.0 X 10^7 and is displayed as 1.0e+07.

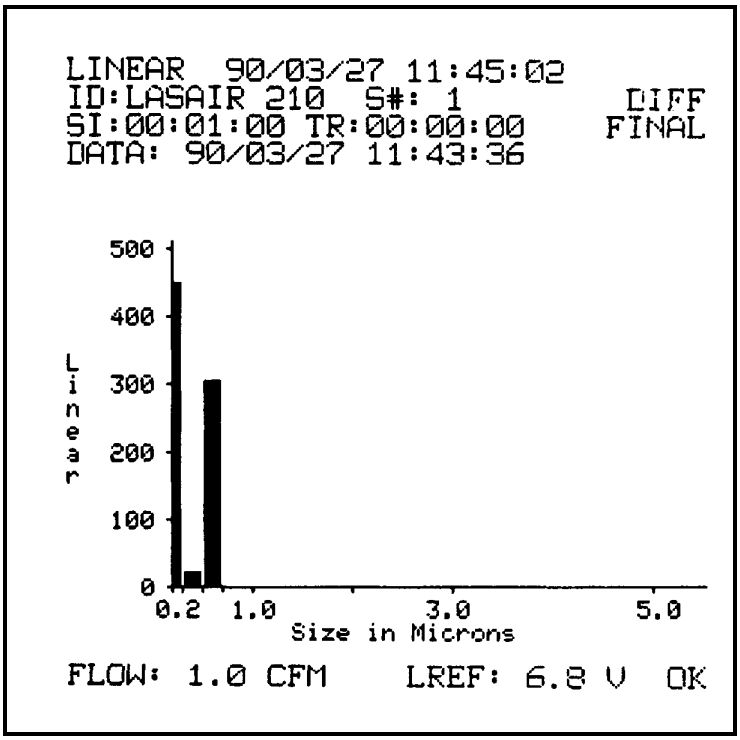
Percent of Total, Linear and Logarithmic Histogram Data Displays

The percent of total, linear and logarithmic data displays show particle counts in size classes. A size class is defined by a range of particle size, for example: 0.2 to 0.3 microns, 0.3 to 0.5 microns, and so on. The size classes reported by your system depend upon which LASAIR model you have. These size classes are displayed on the horizontal axis. The histogram options allow you to determine the value assigned to the vertical scale for each type of display. In addition, the displays can be dynamically changed in increments to increase or decrease the vertical scale. See “Histograms” on page 7-4.

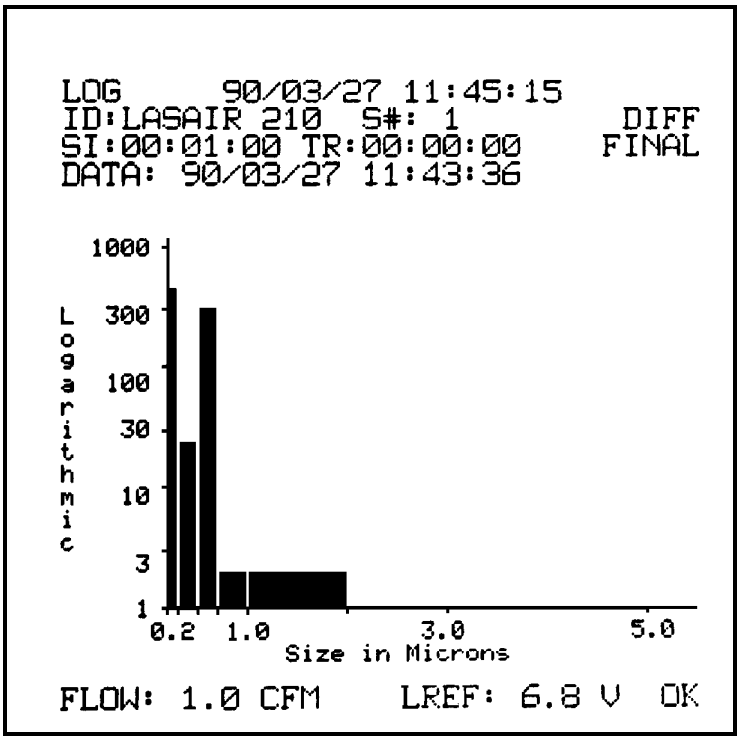
A percent of total display shows what percentage of the total counts presently taken fall into each size class and appears as follows:



A linear display shows the actual counts in each size class and appears as follows:



A logarithmic display shows the actual counts in each size class and appears as follows:

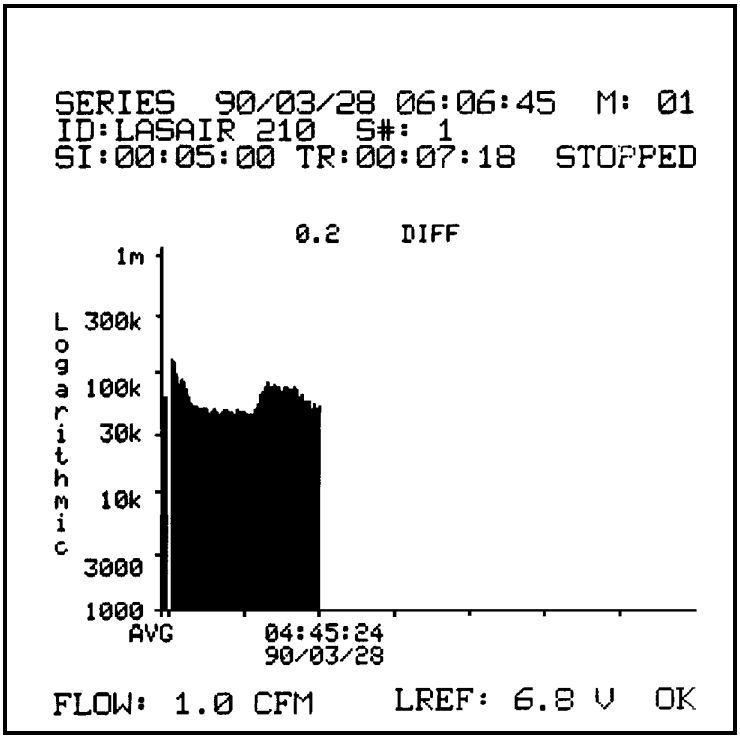


Time Series Data Display

A time series display shows the differential or accumulative logarithmic counts for one selected size class (channel). Only that size class is reported along a time line. The actual logarithmic counts are represented on the vertical axis. One vertical line is drawn for each sample taken. As samples accumulate, a time and date stamp appears at the second and fifth tic mark on the horizontal axis. 90 samples are represented between each stamp.

The time series feature works on single-sample groups only. Be sure to set the Sampling Control menu's # of Samples In Group field to 01. See “Sampling Control” on page 7-2.

A typical time series display looks like this:



The LASAIR can store data from 1470 samples in time series mode (only); therefore, if you were to take one-minute samples with no delay time between samples, you could gather and store approximately 25 hours of data. The LASAIR always retains the time series data from the most recent 1470 samples taken. If you take 1500 samples, the individual data from the first 30 samples will be lost. The average value includes all samples.

210 samples can be displayed on a single screen. If you have data from 1470 samples, you have 7 screens of data. It is possible to scroll the screen from left to right and back to view all of the sample data.

To scroll data:

1. From the time series display, press a number on the alphanumeric keypad that represents the number of screens forward or back you wish to view. For example, if you want to jump 3 screens forward, press the number 3.

   A highlighted message appears at the upper right corner of the data display area: **SCROLL 3**

2. Then, to scroll forward, press the right-arrow key.

3 If you want to scroll back again, press a number on the keypad and use the left-arrow key.

To scroll 1/2 screen, press zero and the arrow key.

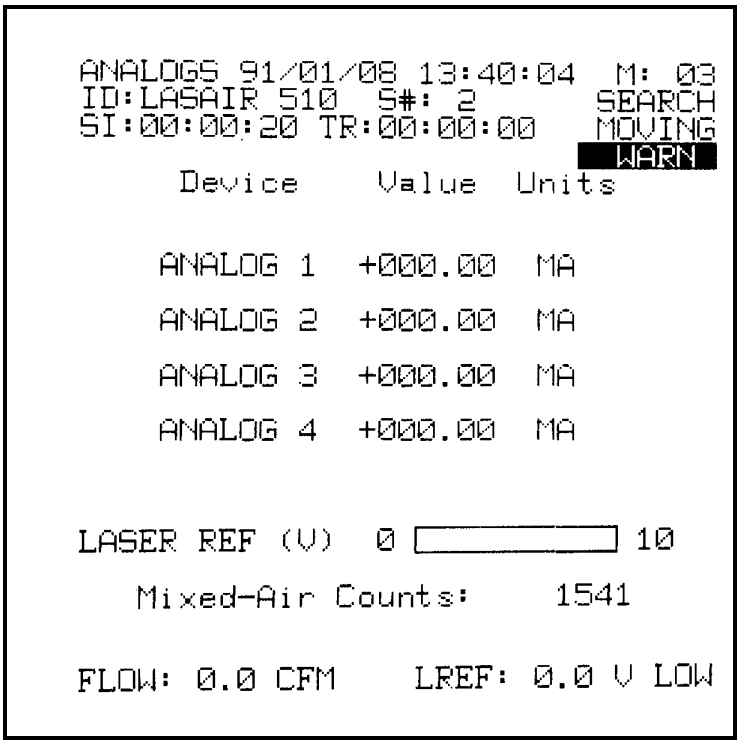
NOTE: Press the Help key for information on scrolling.

If the LASAIR has stored the maximum number of samples and you are viewing the first data screen, when you continue sampling, sample data from the first samples will disappear from the display as the data are dropped from memory. If you have scrolled completely to the right and are viewing the most current (latest) data taken, as new data appears, the screen automatically scrolls to the right so the new data is displayed.

Use Facility Net to print a complete history of the sample data. See the *Facility Net External Printer Software Manual*.

Analog Data Displays

The analog data display monitors the analog input status from each of up to four sensors which may be connected to the LASAIR. In order for the LASAIR to display analog data, each device must be enabled using the Analog option (5) on the Setup Menu. The analog ID and units entered from the Setup Menu are shown for each enabled device in the following format:


ANALOGS 91/01/08 13:40:04 M: 03
ID:LASAIR 510 S#: 2 SEARCH
SI:00:00:20 TR:00:00:00 MOVING
WARN
Device Value Units
ANALOG 1 +000.00 MA
ANALOG 2 +000.00 MA
ANALOG 3 +000.00 MA
ANALOG 4 +000.00 MA
LASER REF (V) 0 10
Mixed-Air Counts: 1541
FLOW: 0.0 CFM LREF: 0.0 V LOW

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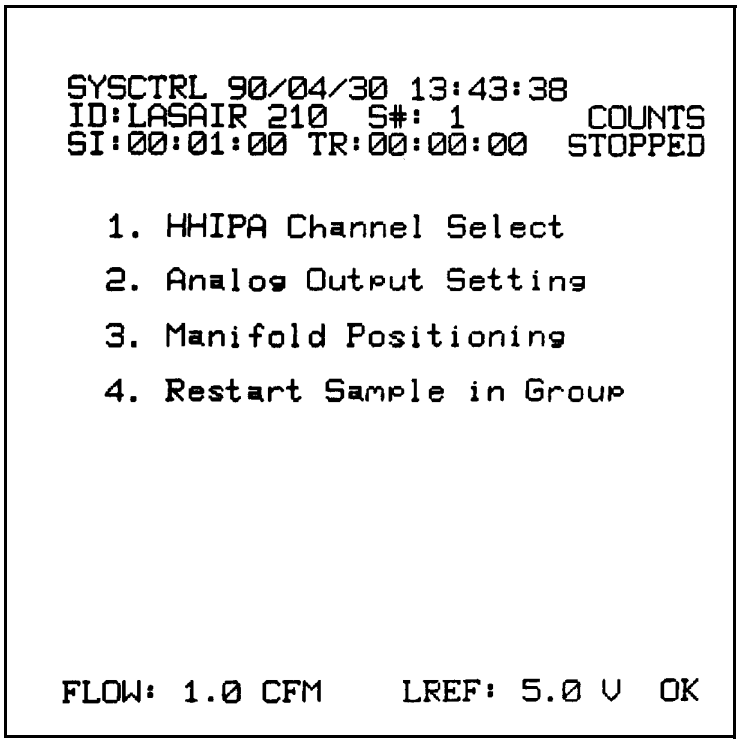
Chapter 9
System Control

The System Control options allow you to perform the following operations:

- set up the HHIPA
- customize an analog output
- set the manifold position
- restart a group sampling with any sample number

This chapter describes each of these options.

To access the System Control options, from a data display, press the SYSTEM CONTROL key on the front panel. The monitor displays:


SYSCTRL 90/04/30 13:43:38
ID:LASAIR 210 S#: 1 COUNTS
SI:00:01:00 TR:00:00:00 STOPPED
1. HHIPA Channel Select
2. Analog Output Setting
3. Manifold Positioning
4. Restart Sample in Group
FLOW: 1.0 CFM LREF: 5.0 V OK

HHIPA Channel Select

Use these options when a HHIPA is attached to the LASAIR to:

- select the accumulative particle size class to be monitored by the HHIPA
- elect whether to use the LASAIR internal audible alarm
- set the alarm threshold

Select Size

Use the right- and left-arrow keys to display each of the size classes available with your instrument. Select the size class to be monitored by the HHIPA and press Enter to confirm. Both the LASAIR internal alarm beeper and the HHIPA beeper are affected by this field.

Particles/Beep (0=OFF)

Use this field to set the following parameters:

- if the LASAIR audible alarm will sound when particles are detected
- the frequency of the alarm

If you do not want the LASAIR alarm to sound, enter all zeros in this field. (Then only the HHIPA will sound an alarm when the alarm threshold is met.)

If you do want the LASAIR alarm to sound, enter the number of counts that will signal the alarm. For example, if you enter 1000 in this field, the LASAIR will beep after 1000, 2000, 3000, etc., counts have been detected.

This field changes the frequency of beeping of the LASAIR internal beeper only, the beeper inside the HHIPA is controlled by the thumb-wheel on the HHIPA. The numbers on the thumb-wheel refer to particle counts in powers of ten; 1= 10 particles, 2 = 100 particles, etc.

NOTE: If you want the LASAIR internal audible alarm to sound, you must also select Audible Alarm: ON from Instrument Configuration (Setup Menu option 1).

Analog Output Setting

The LASAIR has an analog output (labeled ANALOG OUTPUT on the rear panel) which can be configured to follow the sample counts or output a constant current or voltage. When the output is configured to follow sample counts, the output is a 0-10 volt, 4-20 milliamp signal. The maximum value is set by the alarm value. For example, if the alarm is set at 10,000 counts for 0.2 micron particles, a count of 5,000 produces a 5-volt, 12-milliamp signal. Accumulative counts are tracked and updated at the beginning of each sample. The sample counts output may be used to drive a strip chart recorder to produce a continuous record of particle concentration.

Follow Sample Counts

If you want the output to follow the sample counts, select YES. If you do not, and/or you want the output to provide a constant voltage or current, select NO.

Set by Voltage: Current — This option appears only if you selected Follow Sample Counts: NO. Select either VOLTAGE or CURRENT. Press the Enter key to confirm. The screen then displays either:

`mA (4.0 to 19.94):`

or

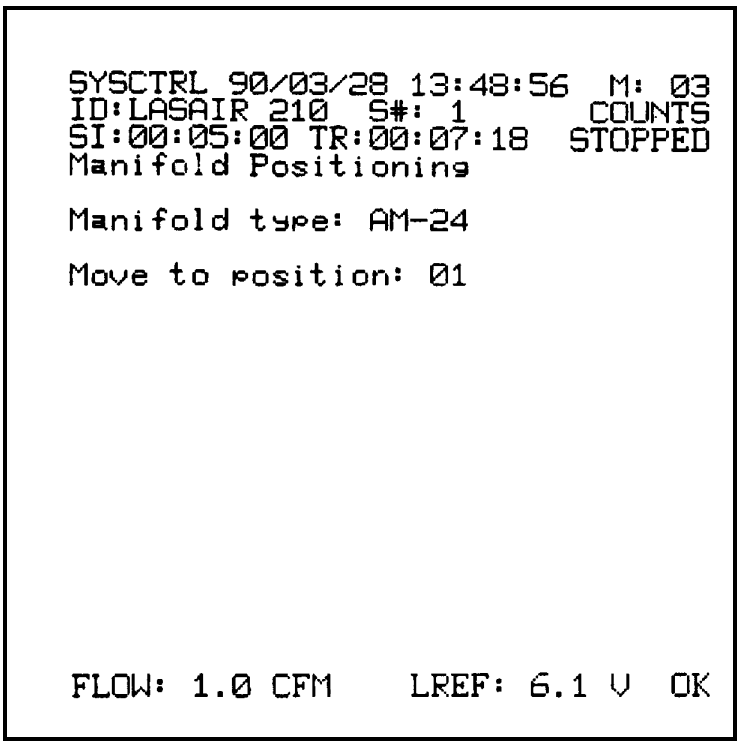
`V (0.0 to 9.96):`

Use the alphanumeric keypad to specify the current or voltage to be continuously output to the ANALOG OUTPUT connector on the rear panel.

Manifold Positioning

NOTE: This option is only accessible if you have a manifold installed and do not have the Manifold Sequence enabled. To disable the Manifold Sequence, select option 7 from the Setup Menu.

Manifold Positioning allows you to move the manifold to any port for sampling. When you select this option the screen displays:


SYSCTRL 90/03/28 13:48:56 M: 03
ID:LASAIR 210 S#: 1 COUNTS
SI:00:05:00 TR:00:07:18 STOPPED
Manifold Positioning
Manifold type: AM-24
Move to position: 01
FLOW: 1.0 CFM LREF: 6.1 V OK

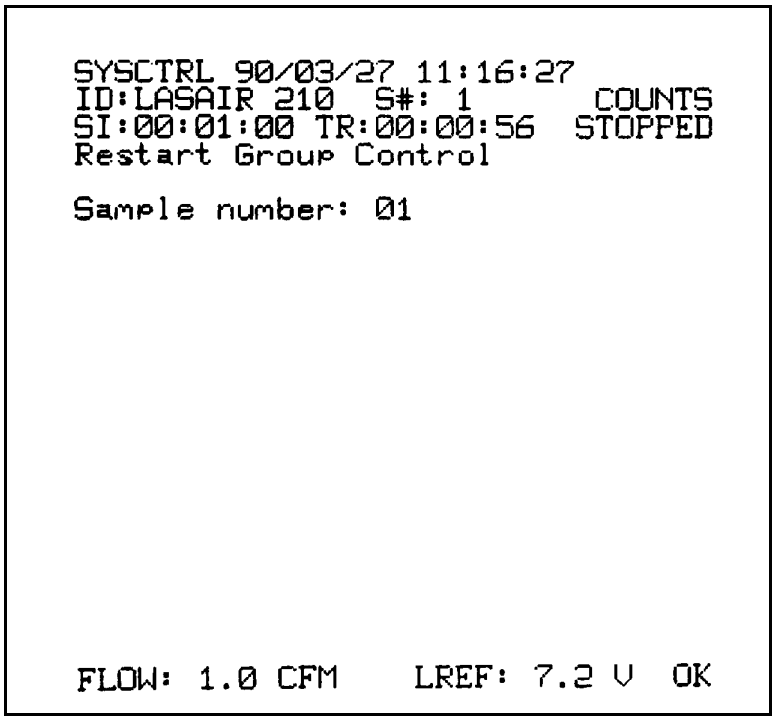
The Manifold Type field is automatically filled in by the LASAIR.

Move to Position

Using the alphanumeric keypad, enter the manifold port you want to sample. Press Enter to confirm your entry.

Restart Sample in Group

Option 4 allows you to restart a group sampling in the middle of a group. The LASAIR displays:


SYSCTRL 90/03/27 11:16:27
ID:LASAIR 210 S#: 1 COUNTS
SI:00:01:00 TR:00:00:56 STOPPED
Restart Group Control
Sample number: 01
FLOW: 1.0 CFM LREF: 7.2 V OK

Use the alphanumeric keypad to designate the sample number on which you want to resume sampling. Press Enter to confirm. The LASAIR begins sampling.

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Chapter 10
Troubleshooting

This chapter is to be used as a guide when the performance procedures reveal that the instrument is not properly calibrated, or has become contaminated, or when you doubt the data or suspect other operational problems.

Instrument Serial Number

If, as a result of following the troubleshooting procedures, you need to contact Particle Measuring Systems, have your instrument serial number handy.

Airflow Rate Errors

Using the airflow rate check (see ‘Airflow Rate Check ’ on page 4-3), the flow rate indicated on the LASAIR display (lower left corner) should be:

Unit Type	Flow Rate	Tolerance
All 1 CFM units	1.0 CFM	± 5%
LASAIR 101	0.10 CFM	± 5%
LASAIR 1001	0.010 CFM	± 5%
LASAIR 1002	0.0020 CFM	± 5%
LASAIR 1003	0.0010 CFM	± 10%
LASAIR 1004	0.280 cc/sec.	± 10%

Variations greater than 5% or 10% (dependent upon model) indicate that the flow rate needs to be adjusted. See ‘Airflow Rate Adjustment (All LASAIR models except for LASAIR-1004) ’ on page 11-15 or ‘LASAIR-1004 Airflow Rate Adjustment ’ on page 11-17.

If completion of the adjustment procedure(s) do not result in the expected flow rate, call Particle Measuring Systems.

Background Counts

When a background count check reveals a high zero count, it is most likely that the unit has been contaminated.

Particle-Induced Counts

Particles can come either from contamination of the inlet jet and tubing or through a small leak in the sample block.

The following equipment is required for this procedure:

- 50 MHz oscilloscope
- Allen socket-head cap screw wrench set
- Spectrophoto grade acetone
- Source of known-clean air

To test for contamination or leaks:

1. Connect the LASAIR to a source of known-clean air.
2. Connect the vertical input of the oscilloscope to the BNC connector on the rear panel labeled HIGH GAIN.
3. Set the oscilloscope as follows:
   - 10 microsec/div
   - 0.5 V/div
   - Trigger - normal
4. Set the trigger level about 0.25 volts below the point where it stops triggering on the baseline noise.

   Particles entering through the inlet jet are carried rapidly in the sample stream through the laser beam by the airflow and produce pulses less than 15 microseconds long. Particles leaking in from other sources drift slowly through the laser beam and produce much longer pulses. If it appears that the particles are coming in through the inlet jet, complete the following steps:
5. Disconnect the sample tubing from the inlet jet and remove the two 4-40 screws that secure the inlet jet.

CAUTION:
Do not bend or damage the tip of the inlet jet.

6. Carefully pull the inlet jet straight out.

7 Inspect the inlet jet for fibers or debris.

WARNING:

Use extreme caution when working with acetone. Wear eye and face protection when cleaning inlet jets.

8 While the inlet jet is removed from the instrument, pour a few milliliters of acetone through the jet. Blow out with filtered compressed air.

9 Replace the inlet jet. Note that the screw holes are slightly offset to ensure correct orientation in the sample block. Check the hole alignment before inserting the screws.

10 Run two 10-minute samples.

11 If, after you have completed this procedure, the problem is not resolved, call Particle Measuring Systems.

Low Laser Reference Voltage

If the laser voltage falls below 4.5 volts, see ‘Cleaning the Crystal Mirror ’ on page 11-6 and determine if the laser is still lasing.

WARNING:

Do not look into the crystal opening! Dangerous laser light is present! Hold a piece of paper or other non-reflective object behind the opening and look for a small red dot.

If the laser is not lasing then contact Particle Measuring Systems’ Service for assistance.

If the laser is lasing and the reference is not higher than 4.5 volts, complete the following procedures from Chapter 11 in this order:

1 Realigning the Crystal Mirror

2 Cleaning the Output Coupler Mirror

3 Cleaning the Crystal Mirror

4 Removing Fibers from the Sample Inlet Jet

After performing each of these procedures, check the laser reference voltage. If the laser reference voltage is not within the acceptable range (4.5 to 9.5 volts), the laser may have failed. Contact Particle Measuring Systems.

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Chapter 11
Routine Maintenance

This chapter provides the following maintenance instructions:

- realigning the crystal mirror
- cleaning the output coupler mirror
- cleaning the crystal mirror
- adjusting the airflow rate
- cleaning the exterior

Although the cleaning procedures described in this chapter are routine tasks, cleaning does not need to be done at regular intervals, and should not be done unless it is necessary. Use these cleaning procedures only if you suspect contamination. Before performing any of the cleaning or alignment procedures, refer to Chapter 10, (Troubleshooting) to determine the best course of action.

Safety

Before performing any of the maintenance tasks described in this chapter, read this section and familiarize yourself with the warnings and caution labels inside the LASAIR.

CAUTION:
Before making or breaking any connections inside the LASAIR, remove power from the instrument by turning the power switch to off and removing the power cord.

Realigning the Crystal Mirror

The crystal assembly is mounted on a flange, which in turn is mounted on the laser optical bench with three screws. A partially compressed o-ring between the flange and the laser optical bench allows the angle of the crystal mirror to be adjusted by turning any of the three screws. Three holes in the oscillator/ preamplifier board provide access to these screws.

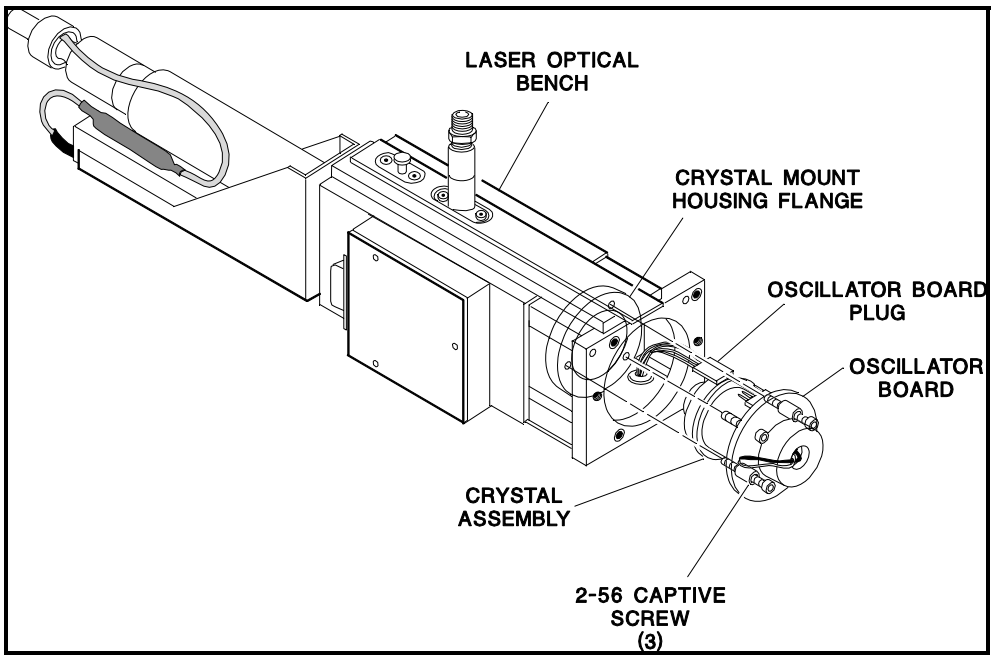


Figure 11-1: Crystal Mirror Assembly

When properly adjusted, the crystal mirror provides maximum laser reference voltage. The laser voltage may be monitored during the alignment procedure either by watching the laser reference voltage displayed on a data screen, or using an oscilloscope. The laser reference voltage is updated on the LASAIR display once each second.

To realign the crystal mirror, adjust the alignment screws according to the following procedure.

The following equipment is needed to realign the external mirror:

- Allen socket-head cap screw wrench set
- Single trace, 50 MHz bandwidth oscilloscope (optional).

NOTE: The reference voltage varies as the laser optical bench warms up. Therefore, when realigning the crystal mirror, do not turn the unit off for extended period. If the optical bench must be de-energized for an extended period, allow it sufficient warm up time before realigning the external mirror.

To realign the external mirror:

1. Place a filter on the sample inlet.
2. Allow the LASAIR to run for an hour to warm up.
3. If you want to use an oscilloscope to monitor the reference voltage, connect it to the BNC connector on the rear panel of the LASAIR labeled REF. The reference voltage is a negative signal; a more negative voltage indicates more laser power.
4. Remove the laser optical bench cover plate from the back panel by removing six 8-32 socket-head screws from the back and two 6-32 screws from the center of the top at the rear of the instrument (Figure 11-2).

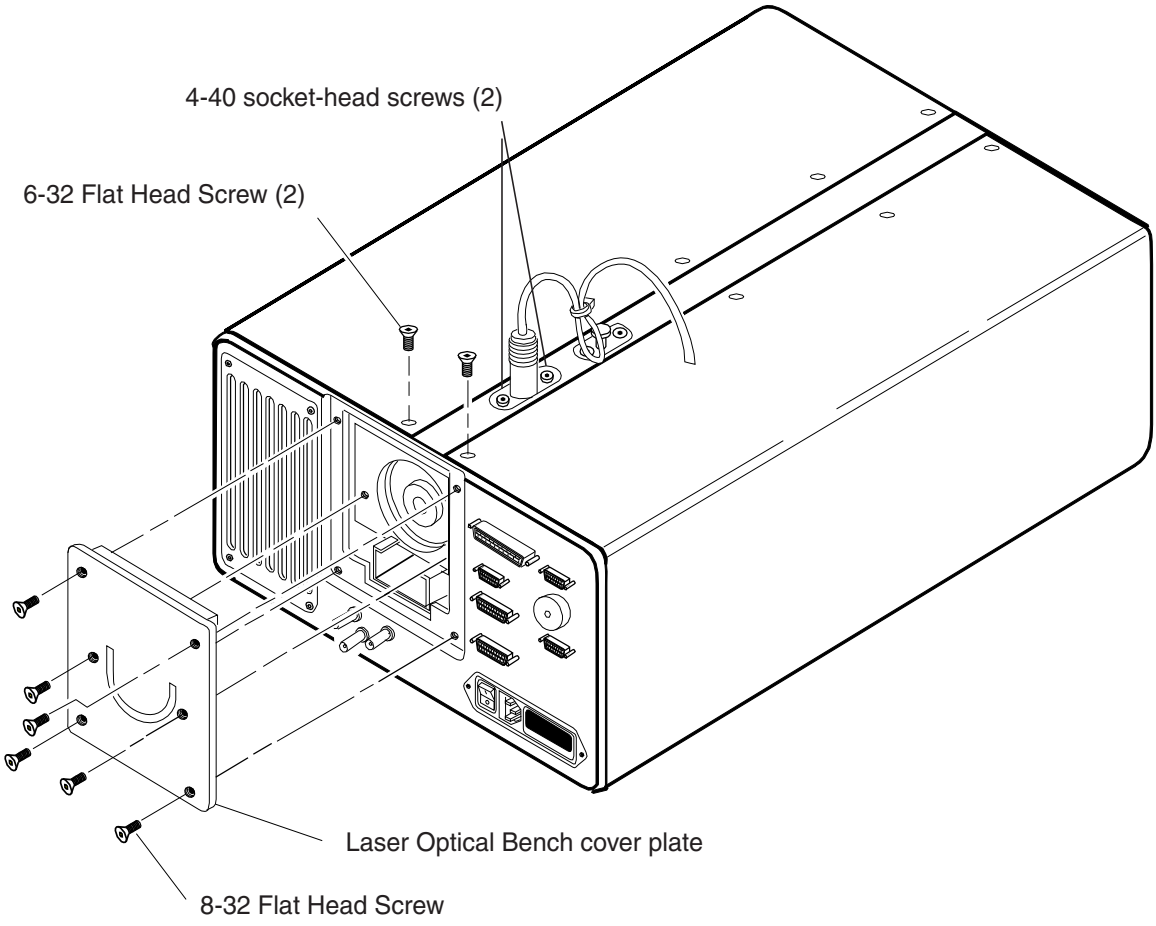


Figure 11-2: Removing the Laser Optical Bench Cover Plate

NOTE: The position of the crystal mirror is highly sensitive to changes in the positions of the adjustment screws.

5 By inserting a 7/64-inch Allen wrench through the access holes in the oscillator/preamplifier board (Figure 11-3), slowly adjust each of the three alignment screws for maximum negative voltage. Monitor the voltage on the oscilloscope or the LASAIR display.

6 When the crystal mirror has been adjusted for satisfactory maximum voltage, return the LASAIR to normal operation by replacing the laser optical bench cover plate and disconnecting the oscilloscope.

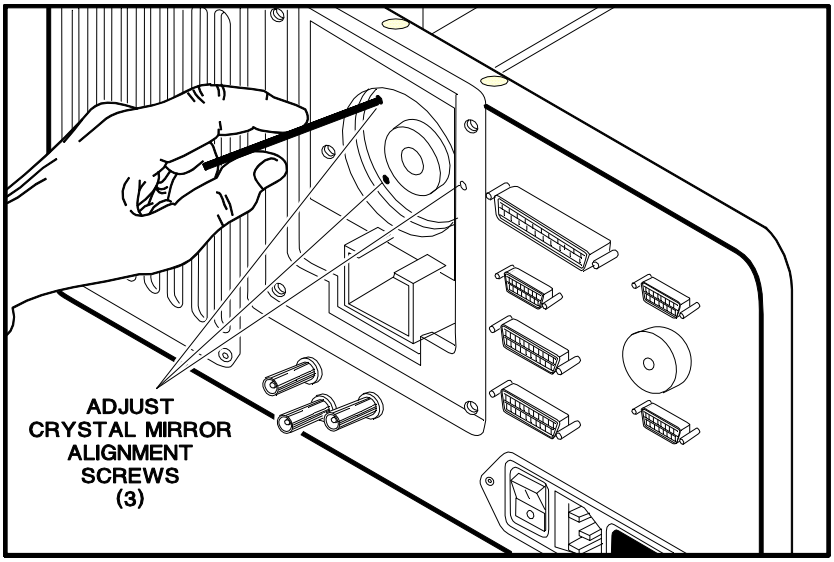


Figure 11-3: Crystal Mirror Alignment Screws

If the reference voltage is still low, see “Optics Cleaning” below.

Optics Cleaning

The following two optical surfaces (see Figure 3-1, “Passive Optical Cavity,” on page 3-1) may require cleaning:

- the output coupler mirror
- the crystal mirror

The passive laser cavity is comprised of the output coupler mirror and crystal mirror. Their cleanliness is critical as the cavity power is sensitive to less than 1% loss. Laser reference voltage is directly affected by the cleanliness of these surfaces.

If the reference voltage is still low after aligning the crystal mirror, either the output coupler mirror or the crystal mirror may need cleaning. Since the output coupler mirror is more accessible, start with it.

Cleaning the Output Coupler Mirror

To clean the output coupler mirror the following equipment is needed:

- Allen socket-head cap screw wrench set
- Spectrophoto grade acetone
- Cotton swabs (Q-Tips)
- Single trace, 50 MHz bandwidth oscilloscope (optional)

NOTE: Use this procedure only after realigning the crystal mirror.

NOTE: The reference voltage varies as the laser optical bench warms up. Therefore, when cleaning the corrective lens, do not turn the unit off for an extended period. If the optical bench must be de-energized for an extended period, allow it sufficient warm up time before realigning the external mirror.

To clean the output coupler mirror:

1. Turn the instrument on and allow the laser reference to stabilize.
2. To set up the (optional) oscilloscope, connect it to the BNC connector on the LASAIR back panel labeled REF.
3. Remove the two 4-40 socket-head screws from the cleaning port (Figure 11-4).

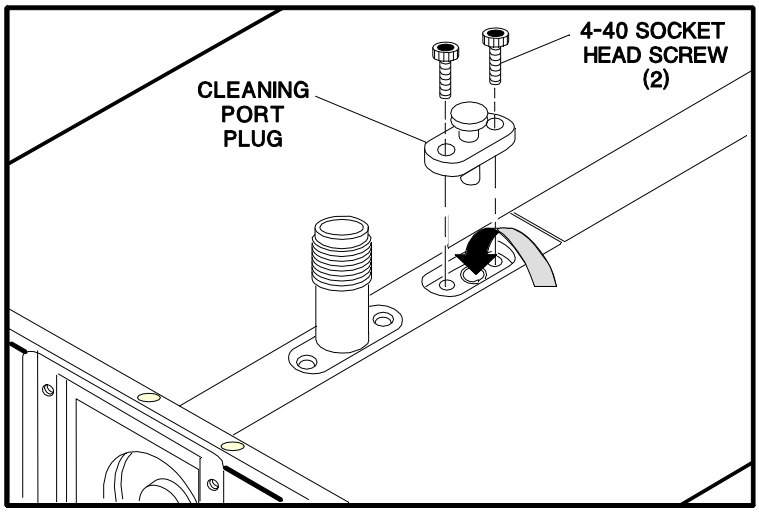


Figure 11-4: Output Coupler Mirror Cleaning Port

4. Turn the LASAIR off.

5 Remove the cleaning port plug.

6 Wet a cotton swab with several drops of acetone, shake off the excess acetone, and clean the output coupler mirror. For best results, use each cotton swab for one wipe only and wipe from the center to the edge.

7 Replace the cleaning port plug.

8 Turn the LASAIR on and check the laser reference voltage for a maximum negative peak. If the reference voltage is lower, the dirt may have been spread over the mirror. If so, repeat steps 4 through 8.

9 If it is higher, repeat steps 4 through 8 to be sure the mirror is completely clean. When the reference voltage remains constant over the course of three cleanings, the laser mirror is clean.

10 Replace the two 4-40 socket-head screws in the cleaning port plug.

If the laser reference voltage has not reached 7.0 volts, clean the crystal mirror.

Cleaning the Crystal Mirror

The crystal mirror is located at the rear of the sample block. Normally, this mirror should be cleaned whenever the output coupler mirror is cleaned. Access to the crystal mirror is gained by removing the crystal assembly.

The following equipment is needed to perform this procedure:

- Allen socket-head cap screw wrench set
- Spectrophoto grade acetone
- Cotton swabs (Q-Tips)

NOTE: Perform this procedure only when the crystal mirror is properly aligned.

NOTE: The reference voltage varies as the laser optical bench warms up. Therefore, when cleaning the crystal mirror, do not turn the unit off for extended lengths of time. If it is necessary to do so, allow the bench to warm up again.

To clean the crystal mirror:

1 Turn the instrument on and allow the laser reference to stabilize.

2 Remove the laser optical bench cover plate from the LASAIR by removing six 8-32 screws from the back panel and two 6-32 screws from the center of the top at the rear of the instrument. Refer to Figure 11-2

3 Turn off power to the instrument.

4 Loosen the three 2-56 captive screws that hold the crystal assembly to the crystal mount housing flange (Figure 11-5).

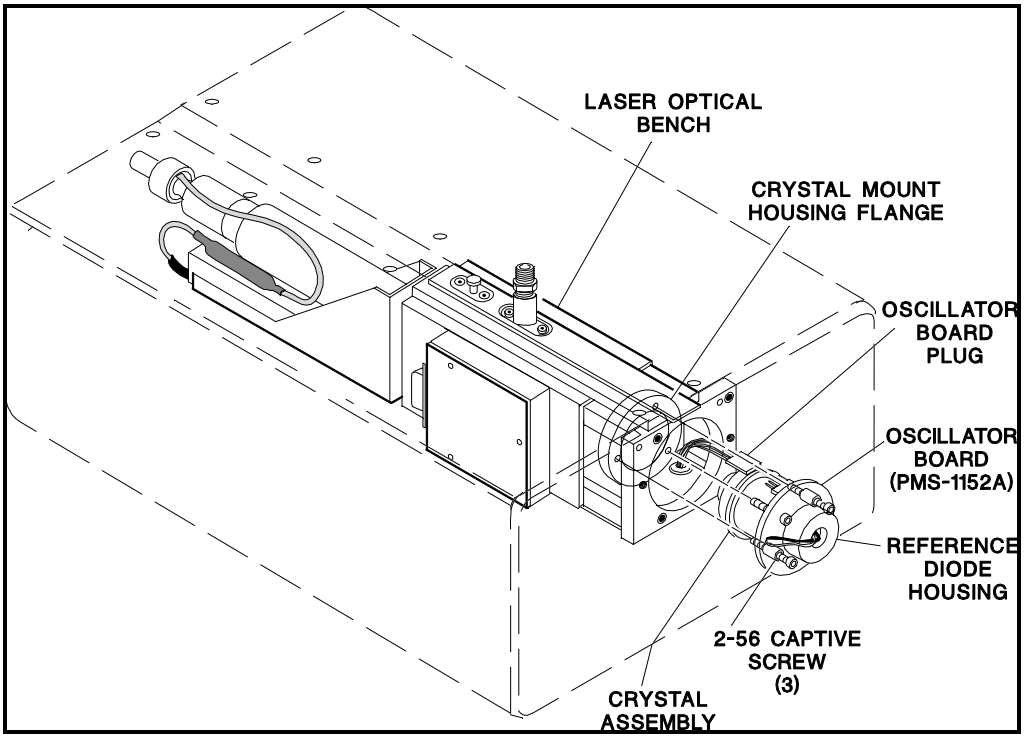


Figure 11-5: Crystal Mirror Assembly

5 Pull the crystal assembly away from the laser optical bench.

6 Disconnect the plug from the oscillator board (Figure 11-5).

7 Note that the surface of the crystal housing around the mirror (Figure 11-6) is "stepped" down at one end of the mirror. Wet a cotton swab with several drops of acetone, shake off the excess acetone, and clean the external mirror with one downward wipe (in the same direction as the "step down"). For best results, use each cotton swab for one wipe only. Before reinstalling the crystal, check for streaks or smudges on the crystal's mirrored surface. If the mirror does not appear to be clean, re-clean and check again.

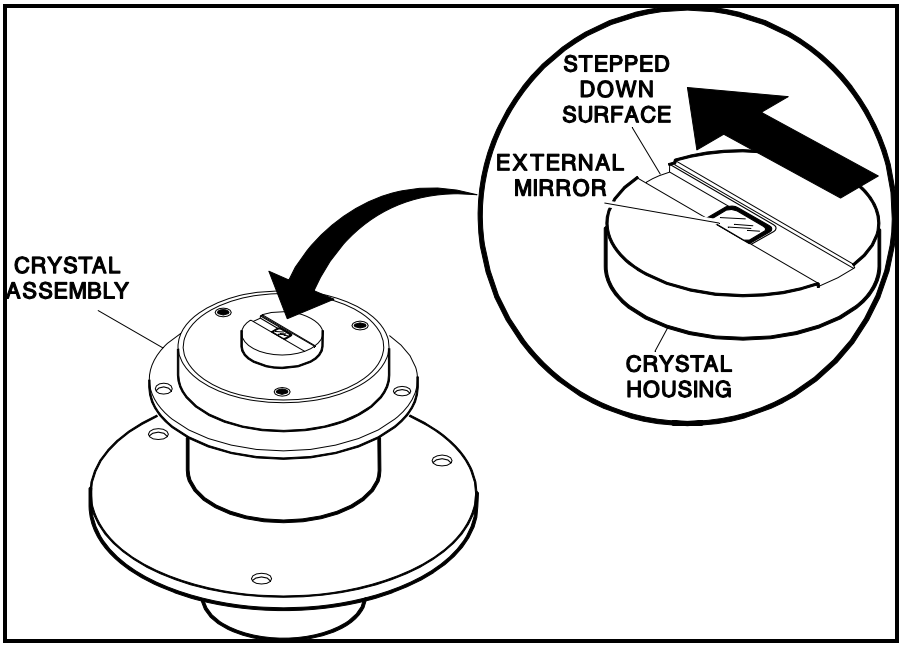


Figure 11-6: Crystal Mirror

8 Connect the plug to the board, replace the crystal mirror assembly, turn the instrument on, realign the crystal mirror, and check the reference voltage. If the reference voltage is lower, the dirt may have been spread over the mirror; repeat steps 3 through 8.

9 If the reference voltage is higher, repeat steps 3 through 8 to be sure the mirror is completely clean. Continue to clean the crystal mirror until the voltage remains at the same level. When the reference voltage remains constant over the course of three cleanings, the crystal mirror is clean.

10 Recheck the crystal mirror alignment.

11 Replace the laser optical bench cover plate.

If the laser reference level has not returned to an acceptable level, refer to Chapter 10, “Troubleshooting.”

Removing Fibers from the Sample Inlet Jet

If you are getting unexplained particle counts or if the reference voltage is still low after cleaning, it is possible that a fiber may be lodged in the sample cavity or inlet jet. To quickly check for fibers, use the following procedure.

Removing the Side Cover from a LASAIR without a Disk Drive

1. Remove the left side cover from the instrument by removing eight 6-32 socket-head screws from the top and bottom of the side cover (Figure 11-7).
2. Slide the side cover off.

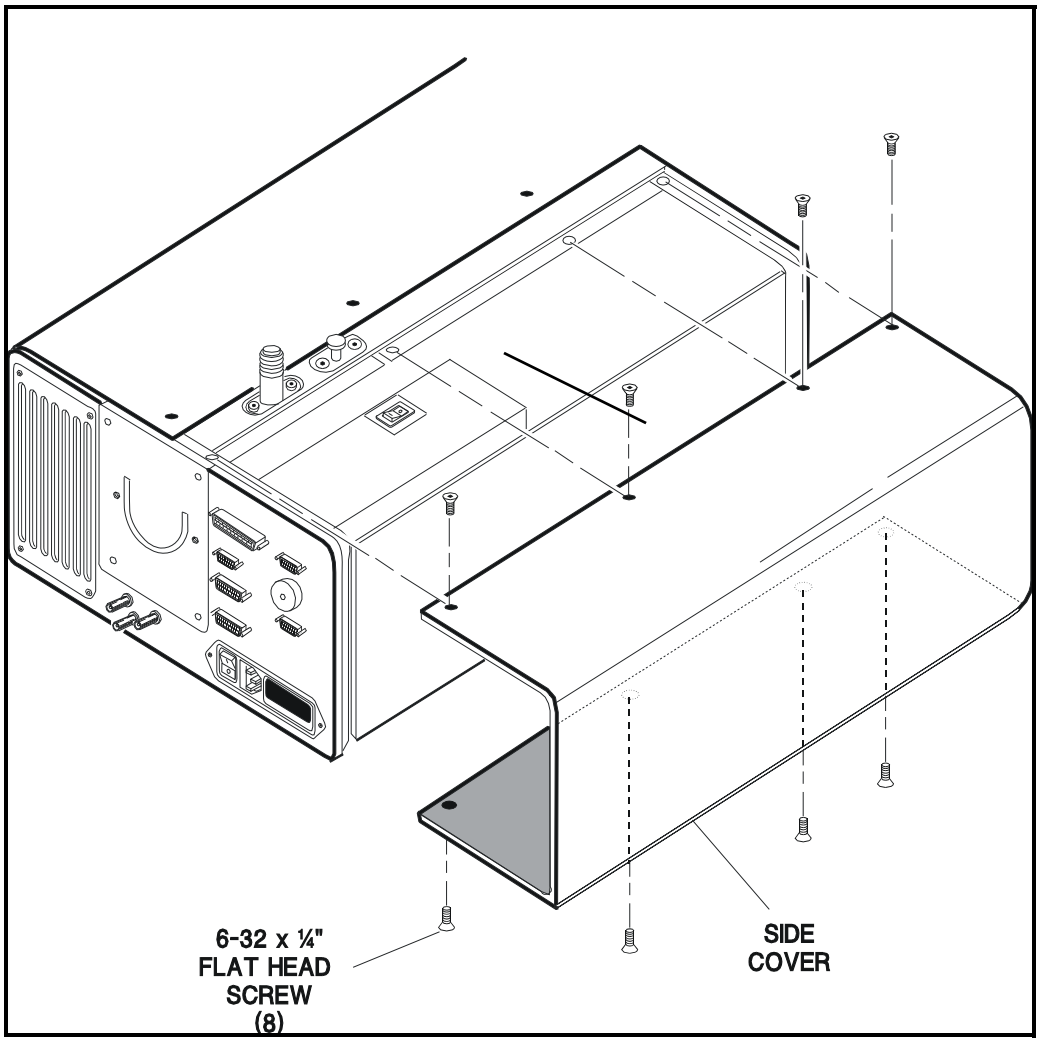


Figure 11-7: Left Side Cover Removal

Removing the Side Cover from a LASAIR with a Disk Drive

If you have a LASAIR with a disk drive and electroluminescent display, use this procedure to remove the side cover. Please read the entire procedure before beginning.

To remove the side cover:

1. Place the instrument on its right side (Figure 11-8).
2. Open the disk drive door by pressing the disk drive release button.
3. Remove the eight 6-32 socket-head screws from the top and bottom of the left side cover.

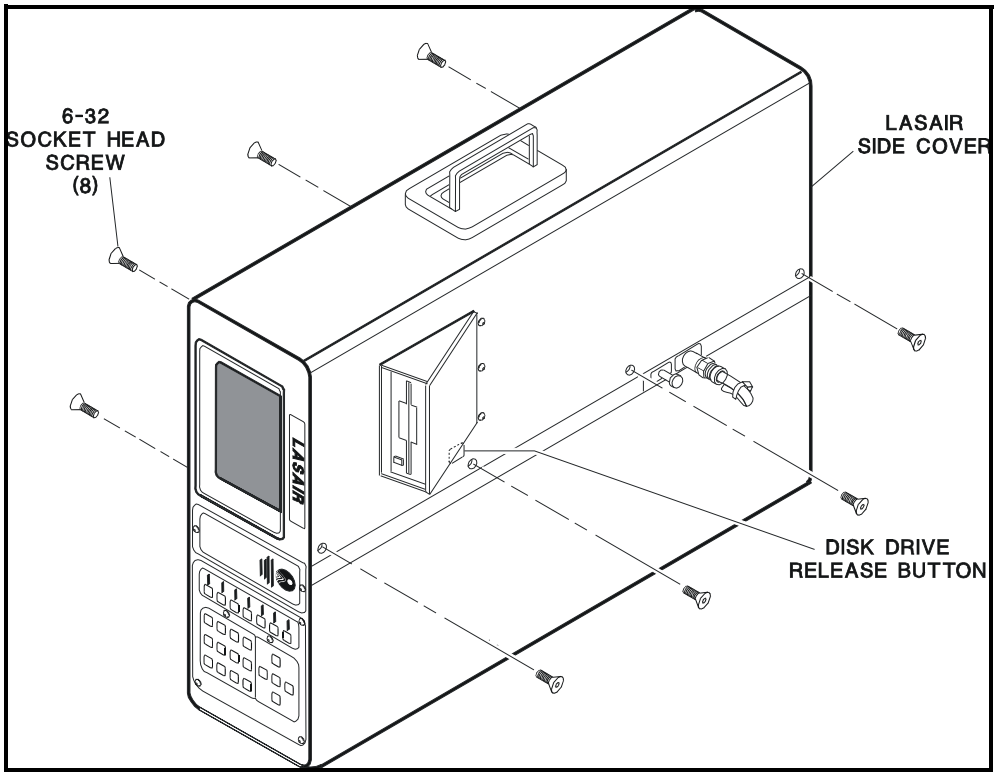


Figure 11-8: Removing the Side Cover

NOTE: After removing the four screws (in the next step), hold the disk drive in place until the cover is removed.

4. Remove the four 4-40 socket-head screws from the disk drive door (Figure 11-9).
5. Fold the disk drive door to the rear of the unit.

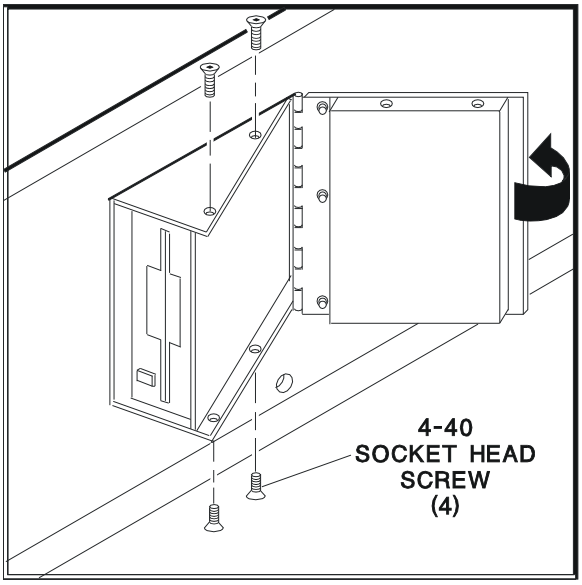


Figure 11-9: LASAIR-EL Cover Removal (Steps 4-5)

CAUTION:
Do not let go of the disk drive until the side cover is removed.

6 Gently push the disk drive back and down. While holding the drive, slowly pull the cover (Figure 11-10) over the disk drive release button and remove the cover.

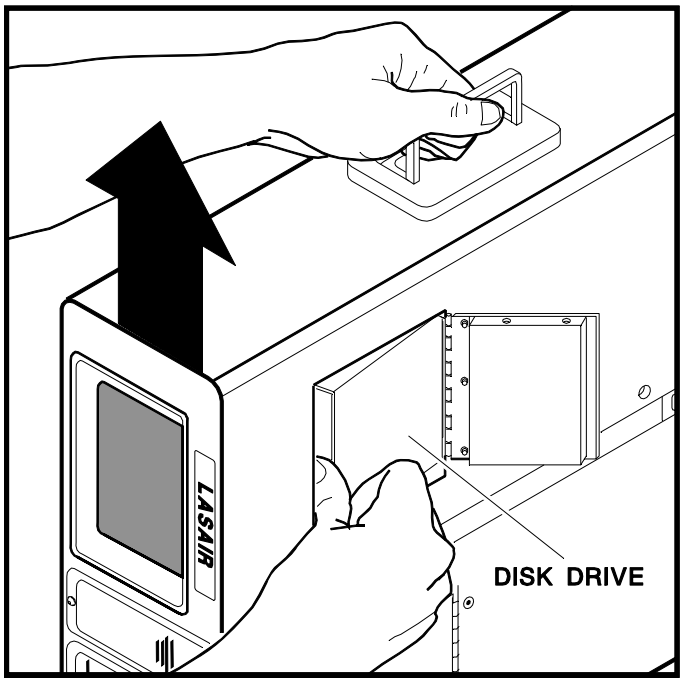


Figure 11-10: LASAIR-EL Cover Removal (Step 6)

CAUTION:
Release the drive slowly (Step 7) to avoid breaking components on the adjacent board.

7 Slowly and carefully release the drive forward and up (Figure 11-11).

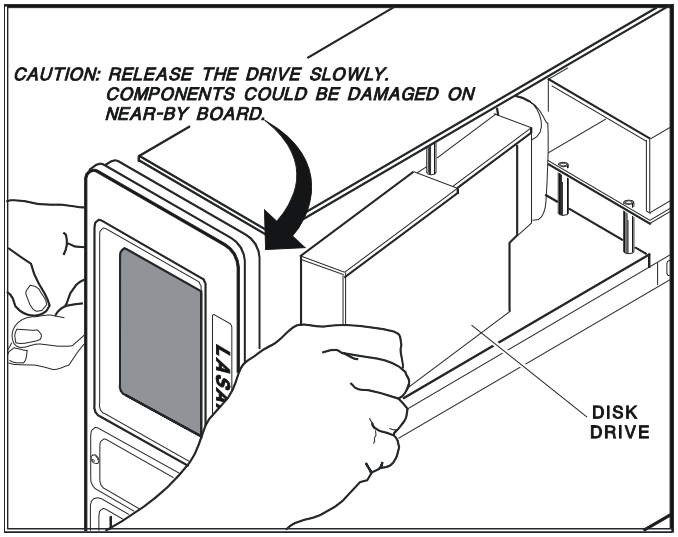


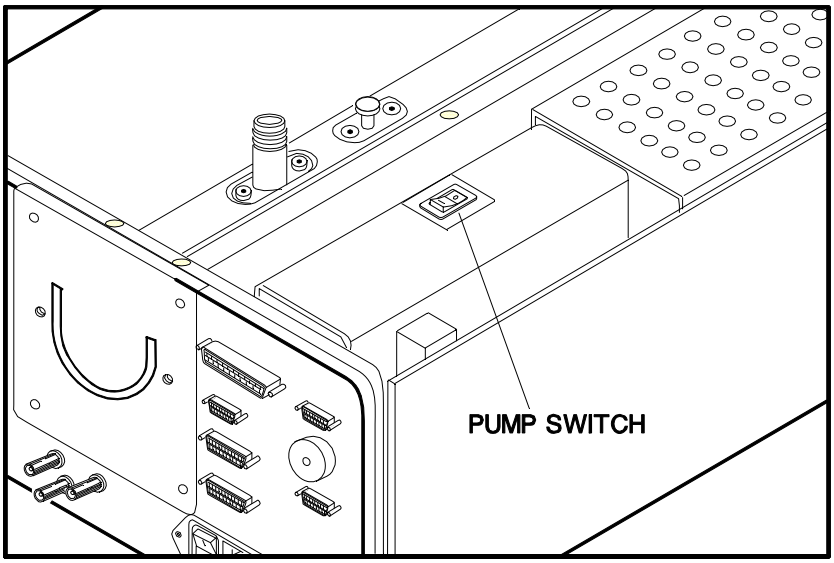
Figure 11-11: LASAIR-EL Cover Removal (Step 7)

Removing, Examining, and Replacing the Inlet Jet

To remove, examine, and replace the inlet jet:

1 Turn the pump off using the pump switch (Figure 11-12).

Later models of the LASAIR have a pump switch which is accessible from the bottom of the unit. Check to see if the unit has an opening on the bottom CRT-side lid for a switch. The pump can be turned off without removing the cover on these units. If the unit is so equipped, go to step number 4.



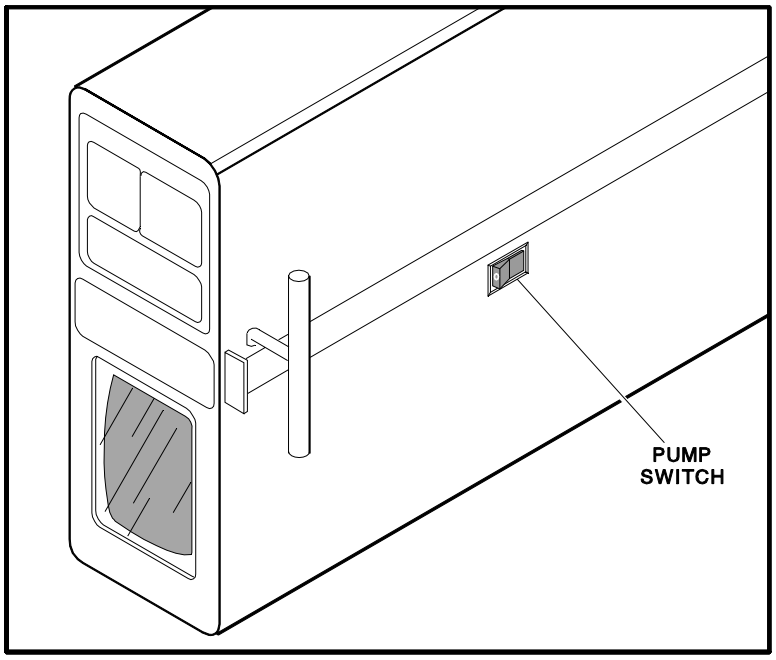


Figure 11-12: Pump Switch Locations

CAUTION:
When removing the sample inlet jet, be careful not to bend or damage the tip of the jet. This may require the LASAIR to be calibrated.

2. Remove the two 4-40 socket-head screws located on the top of the LASAIR on either side of the sample inlet (Figure 11-2) that secure the sample inlet jet. Carefully pull the jet out of the sample block.
3. Use a magnifying lens to look for fibers stuck to the jet tip. Also, turn the LASAIR on and look into the sample cavity through the opening where the jet was. Fibers appear very bright in the laser beam.
4. Use tweezers to remove any visible fibers and replace the jet and screws.
5. Turn the pump on.
6. Replace the cover by reversing the procedure for removing the cover.

   This provides only a cursory check. If you see a fiber but can't reach it with tweezers, or suspect there are fibers you cannot see using this method, contact Particle Measuring Systems.

Airflow Rate Adjustment (All LASAIR models except for LASAIR-1004)

Refer to the next section for LASAIR-1004 airflow rate adjustment.

The LASAIR flow meter works by measuring the pressure drop across a venturi. The LASAIR software makes corrections for altitude and the flow is displayed in the lower left corner of the CRT. The airflow is set by adjusting a valve that controls the amount of air allowed to bypass the pump. The airflow may require adjustment to compensate for long sample tubing or the use of an aerosol manifold. Also, the efficiency of the pump may change with altitude.

The following equipment is needed for this procedure:

- Allen socket-head cap screw wrench set
- Flat-blade screw driver
- Calibrated flow meter (optional)

To adjust the air flowrate:

1 Turn the LASAIR power switch to off.

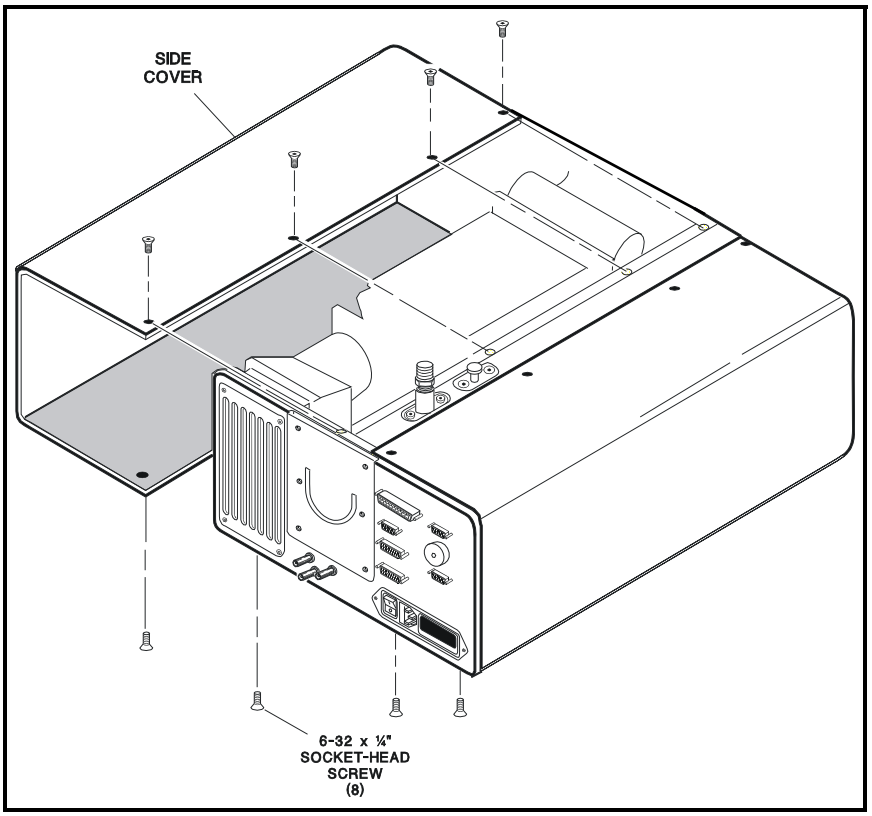


Figure 11-13: Right Side Cover Removal

2. Remove the right side cover from the instrument by removing eight 6-32 socket-head screws from the top and bottom of the cover (Figure 11-13). Gently slide the side cover off.
3. Turn the power switch to on and enter the correct site elevation (ninth option under Instrument Configuration).
4. Locate the airflow rate adjustment valve on top of the plumbing block near the center of the instrument (Figure 11-14). It looks like a slotted brass screw head.
5. To set the flow rate on 1 CFM instruments, turn the adjustment valve clockwise to increase the flow and counter-clockwise to decrease the flow. On lower flow rate units, turn the adjustment valve counter-clockwise to increase the flow and clockwise to decrease the flow.

NOTE: The information contained in Tables 11-1, 11-2, 11-3 and 11-4 is intended for use with rotameters only.

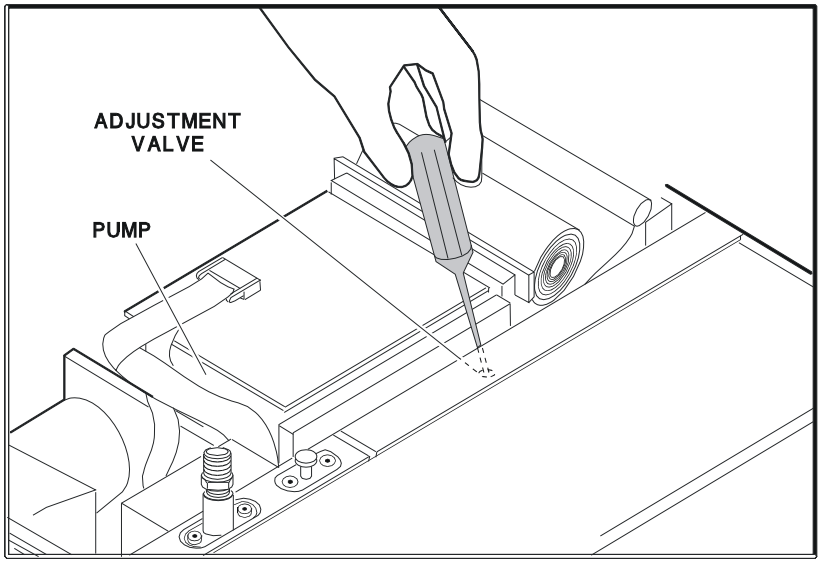


Figure 11-14: Airflow Rate Adjustment Valve

6. To set the flow rate on 1 CFM instruments, turn the adjustment valve clockwise to increase the flow and counter-clockwise to decrease the flow. On lower-flow rate units to increase the flow turn the adjustment valve counter-clockwise and clockwise to decrease.
7. To check the calibration of the LASAIR flow meter, connect a calibrated flow meter to the sample inlet and compare its reading with the LASAIR flow meter. Altitude corrections for rotameter type flow meters are provided in Tables 11-

1, 11-2 and 11-3 and 11-4. If you are using another type of flow meter, refer to its documentation for the appropriate altitude correction.LASAIR-1004 Airflow Rate Adjustment

8 Return the instrument to normal operation by replacing the right side cover.

LASAIR-1004 Airflow Rate Adjustment

The LASAIR-1004 uses a Mass Flow Controller (MFC) to control and monitor the unit's flowrate. To use a volumetric flow rate, the MFC input signal (Control Voltage) and output signal (Output Voltage) must be compensated for altitude. The control voltage is set as described in this procedure using the table 'LASAIR-1004 Mass Flow Controller Altitude Control Voltage' on page 11-21.

The LASAIR software makes corrections to the output signal for altitude, using the altitude entered in this procedure, and displays the calculated volumetric flow rate.

The following equipment is needed for this procedure:

- Allen socket-head cap screw wrench set
- Small flat-blade screw driver
- Volt meter (optional)
- Calibrated flow meter (optional)

To adjust the air flowrate on the LASAIR-1004:

1 Complete steps 1 and 2 of 'Airflow Rate Adjustment (All LASAIR models except for LASAIR-1004)' on page 11-15.

2 Turn the power switch on and enter the correct site elevation (ninth option under Instrument Configuration). See Air Flow Rate Check, page 4-3, for more information.

3 This step is for the optional volt meter. Locate the TP1 ground test point and the control voltage test point (Figure 11-15).

4 Locate the control voltage adjustment potentiometer (Figure 11-15).

5 Refer to Table11-5 'LASAIR-1004 Mass Flow Controller Altitude Control Voltage' on page 11-21. Adjust the potentiometer to the required voltage. If a volt meter is not used, simply adjust the potentiometer until the correct flow rate is displayed on the LASAIR front panel.

6 Verify that the indicated flow rate displayed on the LASAIR front panel is 0.28 cc/sec. ± 10%.

7 To check the calibration of the LASAIR Mass Flow Controller, connect a calibrated flow meter to the sample inlet and compare its reading with the indicated flow displayed by the LASAIR. Altitude corrections for rotameter

type flow meters are provided in Tables 11-1, 11-2, 11-3 and 11-4. If you are using another type of flow meter, refer to its documentation for the appropriate altitude correction.

8 Return the instrument to service by replacing the right side cover.

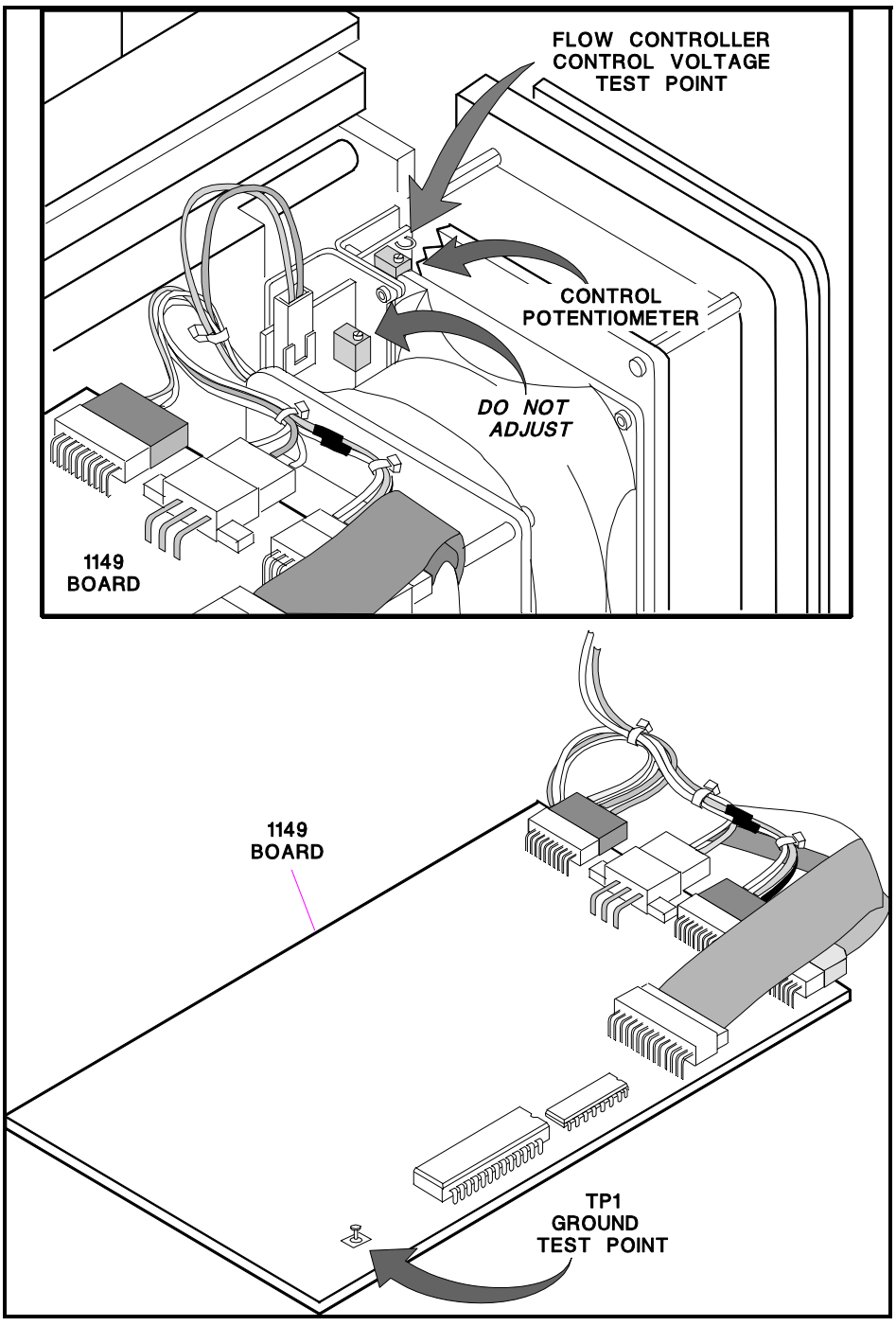


Figure 11-15: Adjustment Test Points

Table 11-1: Flow Meter Altitude Correction Table for 0.01 CFM

Altitude (feet)	CFM	cc/second
0	0.0100	4.72
500	0.0099	4.68
1000	0.0098	4.64
2000	0.0096	4.55
3000	0.0095	4.47
4000	0.0093	4.39
5000	0.0091	4.30
6000	0.0090	4.23
7000	0.0088	4.15
8000	0.0086	4.07
9000	0.0085	3.99
10000	0.0083	3.91

Table 11-2: Flow Meter Altitude Correction Table for 0.1 CFM

Altitude (feet)	CFM	cc/s
0	0.100	47.2
500	0.099	46.8
1000	0.098	46.4
2000	0.096	45.5
3000	0.095	44.7
4000	0.093	43.9
5000	0.091	43.0
6000	0.090	42.3
7000	0.088	41.5
8000	0.086	40.7
9000	0.085	39.9
10000	0.083	39.1

Table 11-3: Flow Meter Altitude Correction Table for 1.0 CFM

Altitude (feet)	CFM	cc/s
0	1.0	472
500	0.99	468
1000	0.98	464
2000	0.96	455
3000	0.95	447
4000	0.93	439
5000	0.91	430
6000	0.90	423
7000	0.88	415
8000	0.86	407
9000	0.85	399
10000	0.83	391

Table 11-4: Flow Meter Altitude Correction for 0.002-0.001 CFM

	0.002 CFM		0.001 CFM	
Altitude (feet)	CFM	cc/sec.	CFM	cc/sec.
0	0.0020	0.94	0.0010	0.47
500	0.0020	0.94	0.0010	0.47
1000	0.0020	0.93	0.00098	0.46
2000	0.0019	0.91	0.00096	0.45
3000	0.0019	0.89	0.00095	0.45
4000	0.0019	0.88	0.00093	0.44
5000	0.0018	0.86	0.00091	0.43
6000	0.0018	0.84	0.00090	0.42
7000	0.0018	0.83	0.00088	0.41
8000	0.0017	0.81	0.00086	0.41
9000	0.0017	0.80	0.00085	0.40
10000	0.0017	0.79	0.00083	0.39

Table 11-5: LASAIR-1004 Mass Flow Controller Altitude Control Voltage

Altitude (feet)	Control Voltage
0	1.4V
500	1.38V
1000	1.35V
1500	1.33V
2000	1.30V
2500	1.28V
3000	1.26V
3500	1.23V
4000	1.21V
4500	1.19V
5000	1.16V

Cleaning the Exterior of the LASAIR

LASAIR covers are brushed nickel-plate and should be cleaned occasionally to maintain the finish. Acids can attack nickel, therefore, cleaning keeps the instrument free of acids in skin oils and foods. If the instrument covers become smudged from handling, clean as soon as possible. Prolonged contact with skin oils can permanently discolor the case.

To clean the nickel surfaces use a soft sponge and a household cleaner such as Fantastic®, Formula 409®, or a laboratory cleaner such as IsoClean®.

CAUTION:

Do not use strong industrial cleaners with high alkali content as they will attack the finish.

Spray the cleaner on the instrument and wipe in the direction of the grain. Dry with a paper towel in the direction of the grain to reduce spotting.

To clean the screen, use any glass cleaner and a soft cloth.

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Chapter 12
Serial Communications

The LASAIR can be connected to a computer or terminal via RS-232C or RS-485 serial interface (but not both at the same time.) Data that has been collected by the LASAIR is then available to the computer or terminal and the LASAIR can be controlled by the serial interface device. The data collected by the LASAIR is transmitted in the form of a data set.

This chapter describes:

- the serial interface for data communications
- the format of the data set
- how the LASAIR can be controlled from a computer terminal

RS-232C Serial Interface

The standard serial configuration is RS-232C.

Interface	RS-232C
Data rate	1200 bps (refer to section on Data Rate)
Character framing	8-bits, one stop bit
Parity	None
Device characteristic	DTE (25-pin female socket, transmits on pin 2, receives on pin 3, signal ground on pin 7, safety ground on pin 1)
Synchronization	Full duplex, no hardware handshake
Protocol (XON/XOFF)	Receive only

To connect the computer or terminal to the LASAIR, run a cable between the LASAIR port labeled RS-232 and the RS-232 port on the computer or terminal. Depending on the configuration of the computer, a NULL MODEM may be needed.

RS-485 Serial Interface

In order to use the RS-485 port on the LASAIR, jumpers must be changed on the 1147D Digital board as follows:

Move jumper from J5 - A, B to J4 - A, B

Move jumper from J5 - C, D to J4 - C, D.

Interface	RS-485
Data rate	1200 bps (refer to section on Data Rate)
Character framing	8-bits, one stop bit
Parity	None
Device characteristic	9-pin male socket, transmit+ on pin 3, transmit- on pin 7, receive+ on pin 5, receive- on pin 9
Synchronization	Full duplex, no hardware handshake
Protocol (XON/ XOFF)	Receive only

To connect the computer or terminal to the LASAIR, run a cable between the LASAIR port labeled RS-485 and the RS-485 port on the computer or terminal or other RS-485 device.

Data Rate

The Data Rate can be changed by changing the jumper setting on the 1147C Digital board. The following table shows the correct settings for J6:

Baud Rate	J1-1	J1-2	J1-3
9600	OPEN	OPEN	OPEN
4800	OPEN	OPEN	JUMP
2400	OPEN	JUMP	OPEN
1200	JUMP	OPEN	OPEN (STANDARD)
600	OPEN	JUMP	JUMP
300	JUMP	OPEN	JUMP

Remote Commands

Please note the following rules for and prerequisites to the use of remote commands with the LASAIR:

- Enter commands in either upper or lower case.
- When issuing a command where parameters follow the two-letter command, follow the command with at least one blank space.
- Terminate each command with a carriage return or line feed (CR/LF).
- Some setup commands are not accepted while the unit is sampling. For example, after the SS (Start Sample) command is issued, a TI (Set Sample Interval) command will be ignored until either an ES (End Sample) command is received or the current sample group is completed.

Valid Commands	
ES	End (abort) the current sample; same as pressing STOP.
SS	Start sampling; same as pressing RUN.
TI nnn	Set the sample interval to nnn seconds.
TD yy/mm/ dd:hh:mm	2 digits. Zero length fields set to 0.
ID ccccccccccc	Set the instrument identification using a maximum of 10 characters. If fewer than 10 characters are specified, the remainder are filled with blanks. Legal characters are upper/ lower case letters, digits, " ", "--", "_", ., ",", "/", ":", and ";".
SN	Set group size to one, repeat mode to continuous.
R nn	Report from sample nn in last group is retransmitted to the terminal.
KG1/0	Keypad lockout enable/disable (1/0); key pad lockout lasts until KG0, KB0, or power cycle.
KB1/0	Same as KG1/0 except power cycle does not enable keypad.

NOTE: Commands TI, TD, and ID change setup parameters and are identical in function to certain setup change commands. They are included only for downward compatibility with earlier versions of Micro LPC software.

Remote Setup Field Changes

Remote commands used to change the SETUP screen fields are issued in the following format:

C nn ssssssss

where:

nn = command number (0-64)

ssssssss = any alphanumeric entry appropriate to the parameter being defined

The instrument must be stopped before some of these commands can be executed. If the instrument is displaying a data screen, the header information will be instantly updated. If the instrument is displaying a setup screen, the screen must be exited and re-entered before new information will be displayed.

The following commands correspond to the Instrument Configuration setup fields:

NOTE: All of these commands may be sent to the LASAIR at any time.

Command Number	Field Effected	Input Notes
3	Time - Hour	24 hour format
4	Time - Minute	00-59
5	Time - Second	00-59
0	Date - Year	00-99
1	Date - Month	01-12
2	Date - Day	01-31
38	Restart on Power-Up	1 = YES, 0 = NO
37	Audible Alarm	1 = YES, 0 = NO
6	Instrument ID	1-10 characters

For example:

C 4 45 <Return>

sets the minutes portion of the time field to 45 minutes.

The site elevation must be set from the LASAIR keypad. All remote communication concentrations and volumes use cubic feet units regardless of the concentration units selected for display on the LASAIR.

The following commands correspond to the Sampling Control setup fields. Those commands with an asterisk by the field name are ignored if the LASAIR is currently executing a group of samples.

Command Number	Field Effected	Input Notes
8	*Sample Length - Hour	00-99
9	*Sample Length - Minute	00-59
10	*Sample Length - Second	00-59
7	*Group Size	00-99
12	*Sample Delay Length - Hours	00-99
13	*Sample Delay Length - Minutes	00-59
14	*Sample Delay Length - Seconds	00-59
16	*Continuous Sampling	1 = YES, 0 = NO
32	*Group Delay Length - Hours	00-99
33	*Group Delay Length - Minutes	00-59
34	*Group Delay Length - Seconds	00-59
11	Sample Point	1 = Enabled 0 = Disabled

For example:

C 7 15 <Return>

sets the # of Samples in Group to 15.

C 12 85 <Return>

sets the hours portion of the Sample Delay Length field to 85 hours.

The following commands correspond to the Post Processing setup fields. These commands may be sent to the LASAIR at any time

Final-display setup fields are only alterable from the LASAIR keypad.

The following commands correspond to the Analogs setup fields. Each command requires that the analog device number be specified after the command number. Devices are numbered 1 through 4. These commands assume the form:

C nn d ssssssss

where d is the device number. These commands may be sent to the LASAIR at any time.

Command Number	Field Effected	Input Notes
25	Device Enabled	1 = YES, 0 = NO
21	ID	1 to 8 characters
24	Units	1 to 6 characters
22	4 mA Value	In device units 0 - 999.99
23	20 mA Value	In device units 0 - 999.99
44	Average Reading	1 = YES, 0 = NO

For example:

C 22 1 10 <Return>

sets the 4 mA Value of Analog 1 to 10 mA.

C 25 3 1 <Return>

sets Analog 3 to Enable.

The following commands correspond to the Alarms setup fields. These commands may be sent to the LASAIR at any time.

Command Number	Field Effected	Input Notes
58	Manifold Port	0 - 12 for AM-12 0 - 24 for AM-24
17	Count Alarm Enable	1 = YES, 0 = NO
19	Size	1 - 8 (e.g., 1 = 1st channel, 2 = 2nd channel, etc.)
41	Differential/ Accumulative	0 = Diff 1 = Accum
42	Counts/ Concentration	0 = Counts 1 = Concentration
20	Maximum Value	1 - 999,999
18		

For example:

C 58 5 <Return>

sets the Manifold Port to #5.

C 20 123000

sets the Maximum Value to 123000.

The following alarm setup-field commands require the analog device number to be specified in the form:

c nn d sssssss

where d is the device number (1 through 4).

Command Number	Field Effected	Input Notes
45	Analog Alarm Enable	1 = YES, 0 = NO
46	Maximum Value	In device units -999.99 - 999.99
47	Minimum Value	-999.99 - 999.99
41	Differential/Accumulative	0 = Diff 1 = Accum

The following commands correspond to Manifold Sequence setup fields. These commands will be ignored if the LASAIR is currently performing a mixed-air search.

Command Number	Field Effected	Input Notes
56	Sequencing Enable	1 = YES, 0 = NO
57	Sequence Length	1-48

The sequence length can be longer than 48 depending on the number of digits in the manifold positions.

27	Sequence 0	Valid numbers 1-12 for AM-12 1-24 for AM-24 1-30 for AM-30

The sequence must be terminated with a 0. The manifold sequence is the order in which ports are sampled. Port numbers are entered with a space between and can be repeated and skipped in any desired pattern. When correctly entered, the manifold sequence will change the sequence length to the number of entries before a 0 is encountered. If the sequence is too long or has an invalid number, the sequence length will default to one and the port number to one.

eg. C 27 12 11 11 12 11 10 1 2 3 0 <ENTER>

The following commands correspond to the Mixed-Air Monitor setup fields. The commands with an asterisk in the field name are ignored if the LASAIR is performing a mixed-air search.

Command Number	Field Effected	Input Notes
60	Mixed Air Alarm Enable	1 = YES, 0 = NO
28	Mixed Value	1-999,999
29	Search Value	1-999,999
59	* Search Sample Length - Hours	0-99
30	* Search Sample Length - Minutes	0-59
31	* Search Sample Length - Seconds	0-59

Report Protocol

If the external printer is connected and energized, the LASAIR will generate a report upon completion of any sample. This report is transmitted out the RS-232 port at 1200 baud, with 8 data bits, one stop bit, no parity. All data is in ASCII.

Format

Figure 12-1 shows an example of a data display. The LASAIR reports are formatted in such a way that the number of spaces between fields is not necessarily constant. The information is set up using lines, numbers and floating fields. The information contained on a line and the number of fields on a line will be constant but the number of spaces between the fields can vary. A line is defined by a CR/LF.

```
LASAIR 510
90/11/02 10:10:22
10.0     0.99     V4.0  0   0   0 1
56437     4054      149       20        6         9         1          2
9.023     0.943     0.000     0.000     0.000     0.000     0.000
2201
```

Figure 12-1: RS-232

Reported data appears in the following sequence:

Field	Notes
STX (Not shown on printed report)	Start transmission
Sample ID	Enter in instrument setup
Year/Month/Day	
Hour/Minute/Second	
Sample interval	In seconds
Sample volume	In cubic feet
Software version	VX.XX
0	Always zero
1/0	1 if searching
Manifold position	(or 0 if none)
Sample number	1-50
Data (differential counts)	Eight values
Laser reference voltage	0.000-10.000
Airflow rate	CFM (cubic feet per minute)
Analog data	Four values in device units
0.000	Always 0.000 (unusable analog)
Checksum	Integer value, simple additive of ASCII bytes
ETX (not shown on printed report)	End transmission
STX (not shown on printed report)	Start transmission
Sample ID (not shown on printed report)	Enter in instrument setup

NOTE: The STX and ETX characters (hex 02 and 03) will generally not appear on a terminal screen.

The timestamp: represents the time the sample ended.

The following sampling parameters:

- Sample interval
- Sample volume
- Version number
- Manifold position
- Sample number

appear in seven fields separated by one or more blanks.

Sample interval: is the duration of the sample in seconds and is accurate to 0.1 second.

Sample volume: is the number of cubic feet measured, accurate to two decimal places.

Software version: is in the form:

Vnn.r

where:

nn = the number representing the current release of Particle Measuring Systems software

r = the minor revision number

Manifold position: is a two-digit number designating the current position of the aerosol manifold.

Sample number: is the number of the sample in the group.

If the checksum does not agree with your calculations, use the R nn command to retransmit the data.

Communication Pin Outs

Connector	PIN	Function
Analog Out	6	Ground
	1	0-10 vdc Out
	2	4-20 mA Out
	5	External Alarm
	9	Digital Output
Analog In	15	Analog 1 Positive
	8	Analog 1 Negative
	7	Analog 2 Positive
	14	Analog 2 Negative
	13	Analog 3 Positive
	6	Analog 3 Negative
	5	Analog 4 Positive
	12	Analog 4 Negative
	3	Frequency in Positive
	10	Frequency in Negative
	1	+24 vdc Output
	2	Ground
RS-232	1	Ground
	2	Transmit
	3	Receive
	7	Ground
RS-485	5	In Positive
	9	In Negative
	3	Out Positive
	7	Out Negative

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Appendix A
International Precautions

WARNING

This instrument is a Class I laser product. Use of controls, or adjustment, or performance of procedures other than those specified here may result in hazardous radiation exposure.

AVERTISSEMENT

Cet instrument contient un laser de Classe 1. L'usage de moyens ou procédures, ou la pratique de certains réglages autres que ceux prévus dans ce manuel peuvent entrainer des risques d'exposition aux radiations laser.

WARNUNG

Das Gerat ist ein Laser der Klasse 1. Werden Einstellungen vorgenommen oder Verfahren eingesetzt, die nicht in dieser Bedienungsanleitung beschrieben sind, kann es zu gefahrlicher Strahlung kommen.

ATTENZIONE

Questo strumento e nella classe 1 dei prodotti laser . Fare controlli o calibrazioni e seguire procedure diverse da quelle specificate in questo manuale, pu provocare esposizione a radiazioni pericolose.

PRECAUSION

Este equipo es un producto laser de Clase I. La utilización de controles, ajustes o procesos diferentes de los especificados aquí, pueden dar lugar a exposiciones a radiaciones peligrosas.

Hazard Symbols

The meaning of hazard symbols appearing on the equipment is as follows:

Symbol	Nature of Hazard
	Attention, consult accompanying documents.
	Dangerous High Voltage

Symboles de risque

Des symboles représentant les risques sont placés sur l'appareil. Leur signification est la suivante :

Symbole	Nature du risque
	Attention, consulter les documents d’accompagnement
	Danger Electricite

Warnschilder

Die, an dem Gerat angebrachten Warnschilder haben folgende Bedeutungen:

Symbol	Gefahrenart
	Achtung! In den beiliegenden Unterlagen nachschlagen
	Achtung Hochspannung

Simboli di pericolo

Il significato dei simboli di pericolo che appaiono sugli strumenti il seguente:

Simbolo	Natura del pericolo
	Attenzione. Consultare i documenti allegati
	Tensione Pericolosa

Simbolos de peligro

Los simbolos de peligro que aparecen en el equipo significan:

Símbolo	Naturaleza del Peligro
	Atención, consultar los documentos adjuntos.
	Peligro alto voltaje.